

Attachment A

**SPECIFICATIONS FOR
REPAIR SEWER SYSTEMS
PHASE 4**



**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GLENN RESEARCH CENTER
21000 BROOKPARK ROAD, CLEVELAND, OHIO 44135**

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SECTION 01090

SOURCES FOR REFERENCE PUBLICATIONS

06/96

PART 1 GENERAL

1.1 REFERENCES

Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

444 N. Capital St., NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806

AMERICAN CONCRETE INSTITUTE (ACI)

P.O. Box 19150
Detroit, MI 48219-0150
Ph: 313-532-2600
Fax: 313-533-4747

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

8300 Boone Blvd., Suite 400
Vienna, VA 22182
Ph: 703-821-1990
Fax: 703-821-3054

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

One E. Wacker Dr., Suite 3100
Chicago, IL 60601-2001
Ph: 312-670-2400
Fax: 312-670-5403

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

11 West 42nd St
New York, NY 10036
Ph: 212-642-4900
Fax: 212-302-1286

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1916 Race St.
Philadelphia, PA 19103
Ph: 215-299-5585
Fax: 215-977-9679

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

22 Law Dr., Box 2300
Fairfield, NJ 07007-2300
Ph: 800-843-2763
Fax: 201-882-1717

AMERICAN WATERWORKS ASSOCIATION (AWWA)

6666 West Quincy
Denver, CO 80235
Ph: 800-926-7337
Fax: 303-795-1989

AMERICAN WELDING SOCIETY (AWS)

P.O. Box 351040
Miami, FL 33135
Ph: 800-443-9353
Fax: 305-443-7559

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

P.O. Box 286
Woodstock, MD 21163-0286
Ph: 410-465-3169
Fax: 410-465-3195

CODE OF FEDERAL REGULATIONS (CFR)

Order from:
Government Printing Office
Washington, DC 20402
Ph: 202-783-3238
Fax: 202-275-7703

CORPS OF ENGINEERS (COE)

Order from:
U.S. Army Engineer Waterways Experiment Station
ATTN: Technical Report Distribution Section, Services
Branch, TIC
3909 Halls Ferry Rd.
Vicksburg, MS 39180-6199
Ph: 601-634-2355
Fax: 601-634-2506

COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

5203 Leesburg Pike, Suite 708
Falls Church, VA 22041
Ph: 703-931-4533
Fax: 703-379-1546

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Public Information Center
401 M St., SW
Washington, DC 20460
Ph: 202-260-2080

FEDERAL AVIATION ASSOCIATION (FAA)

Order from:
Superintendent of Documents
Government Printing Office
Washington, DC 20402-9371
Ph: 202-783-3238
Fax: 202-512-2750
For free documents, order from:
Dept. of Transportation
ATTN: M443.2
400 Seventh St., SW
Washington, DC 20590
Ph: 202-366-4000
Fax: 202-366-2795

FEDERAL SPECIFICATIONS (FS)

Order from:
Standardization Documents Order Desk
Bldg 4D
700 Robbins Av
Philadelphia, PA 19111-5094
Ph: 215-697-2179
Fax: 215-697-2978

FEDERAL STANDARDS (FED-STD)

Order from:
Standardization Documents Order Desk
Bldg 4D
700 Robbins Av
Philadelphia, PA 19111-5094
Ph: 215-697-2179
Fax: 215-697-2978

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

445 Hoes Ln, P. O. Box 1331
Piscataway, NJ 08855-1331
Ph: 800-678-4333
Fax: 908-981-9667

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

127 Park St., NE
Vienna, VA 22180
Ph: 203-281-6613

MILITARY SPECIFICATIONS (MS)

Order from:
Standardization Documents Order Desk
Building 4, Section D
700 Robbins Ave.
Philadelphia, PA 19111-5094
Ph: 215-697-2179
Fax: 215-697-2978

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

2101 L St., NW, Suite 300
Washington, DC 20037-1526
Ph: 202-457-8474
Fax: 202-457-8473

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

P.O. Box 9146
Quincy, MA 02269
Ph: 800-344-3555
Fax: 617-984-7057

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION
(SMACNA)

P.O. Box 221230
Chantilly, VA 22022
Ph: 703-803-2980
Fax: 703-803-3732

UNDERWRITERS LABORATORIES (UL)

333 Pfingsten Rd.
Northbrook, IL 60062
Ph: 708-272-8800, ext 42612
Fax: 708-272-8129

PART 2 PRODUCT (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01110

SUMMARY OF WORK
09/96

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this project consists of providing the services, labor, equipment, and materials to perform a base contract, and at the discretion of the Government, four options. The work includes maintaining all sewage flow.

Base Contract : Construct the following

Sanitary Sewers:

1. Walcott Road Sanitary Sewer from Moffett Road (MH 140) to the east property line with the Cleveland Hopkins International Airport (MH 332), approximately 2,100 meters, including laterals and service connections;
2. K Road sanitary sewer from Walcott Road (MH 220) to Taylor Road (MH 450), approximately 145 meters, including service connections;
3. Reline the existing sanitary sewer from Walcott Road (MH 150) to Building 64 (MH 151);
4. Reline the existing sewer from Walcott Road sanitary sewer (MH 255) to Building 113 (MH 256), approximately 58 meters.

Storm Sewers:

1. Walcott Road storm sewer from SMH 100 to SMH 120, and a service connection to Building 54, approximately 141 meters;
2. Structure 91, Low Pressure Fuel Pumping Station, storm sewer and oil/water separator from SMH 200 to SMH 202, approximately 65 meters.
3. Install a catch basin in the parking area for the 10x10 Supersonic Wind Tunnel off Walcott Road.
4. Building 94-storm sewer from existing SMH 643018 to SMH 312, approximately 62 meters.

Oil/Water Separator:

1. Structure 91, Low Pressure Fuel Pumping Station, remove an existing oil/water separator, and install an oil/water separator.

Option : Construct the following

Sanitary Sewers:

1. Taylor Road sanitary sewer from MH 450 to MH 490, approximately 254 meters including laterals and service connections.

Option : Construct the following

Sanitary Sewers:

1. K Road sanitary sewer from MH 460 to MH 462, approximately 73 meters including service connections.

Option :

Sanitary Sewers:

1. J Road sanitary sewer from MH 462 to MH 465, approximately 102 meters including service connections.

Option : Construct the following

Sanitary Sewers:

1. J Road sanitary sewer from MH 480 to MH 484, approximately 120 meters including service connections;
2. Remove a septic tank.

Oil/Water Separators:

1. Remove two oil/water separators located southeast of Building 34.

The project also includes maintaining the sewage flow, traffic control, soil disposal, survey and layout, obtaining the required permits, and demolition and restoration of the project area.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-18 Records

Submit the following items to the Contracting Officer:

Utility Outages
Connection Request
Borrow Permits
Excavation Permits
Welding Permits
Burning Permits

1.4 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

| <u>Drawing No</u> | <u>Title</u> |
|-------------------|--|
| CF-171680 | Cover Sheet |
| CF-171681 | Sheet Index |
| CF-171682 | Schematic/Key Plan |
| CF-171683 | Survey Control |
| CF-171684 | Walcott Road -- Sanitary Plan & Profile, MH 140 to MH 190 |
| CF-171685 | Walcott Road -- Sanitary Plan & Profile, MH 190 to MH 230 |
| CF-171686 | Walcott Road -- Sanitary Plan & Profile, MH 230 to MH 250 |
| CF-171687 | Walcott Road -- Sanitary Plan & Profile, MH 250 to MH 290 |
| CF-171688 | Walcott Road -- Sanitary Plan & Profile, MH 290 to MH 320 |
| CF-171689 | Walcott Road -- Sanitary Plan & Profile, MH 320 to MH 350 |
| CF-171690 | Walcott Road -- Sanitary Miscellaneous Profiles |
| CF-171691 | Walcott Road -- Sanitary Miscellaneous Profiles |
| CF-171692 | Walcott Road -- Sanitary Miscellaneous Profiles |
| CF-171693 | Walcott Road -- Storm, MH S100 to MH S120 |
| CF-171694 | Flow Meter Electrical Plan and Profile |
| CF-171695 | Westover Road -- Sanitary Plan & Profile |
| CF-171696 | "K" Road -- Sanitary Plan & Profile, MH 220 to MH 410 |
| CF-171697 | "K" Road -- Sanitary Plan & Profile, MH 410 to MH 460 |
| CF-171698 | "K" Road -- Sanitary Miscellaneous Profiles |
| CF-171699 | "M" Road -- Sanitary Plan & Profile |
| CF-171700 | 10x10 Building -- Sanitary Plan & Profile |
| CF-171701 | Taylor Road -- Sanitary Plan |
| CF-171702 | Materials Laboratory Area Miscellaneous Sanitary Profiles |
| CF-171703 | Materials Laboratory Area Miscellaneous Sanitary Profiles |
| CF-171704 | Research Combustion Lab Area -- Plan |
| CF-171705 | Research Combustion Lab Area -- Plan |
| CF-171706 | Research Combustion Lab Area -- Miscellaneous Profiles |
| CF-171707 | Research Combustion Lab Area -- Miscellaneous Profiles |
| CF-171708 | Details -- Sewers |
| CF-171709 | Pavement, Curb & Walk -- Details |
| CF-171710 | Cathodic Protection System -- Installation Details |
| CF-171711 | Miscellaneous Details |
| CF-171712 | Existing Oil Separator Pit & Septic Tank -- Removal Details |
| CF-171713 | Soil Borings |
| CF-171714 | Soil Borings |
| CF-171715 | Soil Borings |
| SK-TC-01 | Road & Parking Area Closure Key Plan |
| SK-TC-02 | Road & Parking Area Closure Segment 1 |
| SK-TC-03 | Road & Parking Area Closure Segment 2 |
| SK-TC-04 | Road & Parking Area Closure Segment 3 |
| SK-TC-05 | Road & Parking Area Closure Segment 4 |
| SK-TC-06 | Road & Parking Area Closure Segment 5 |
| SK-TC-07 | Road & Parking Area Closure Segment 6 |
| SK-TC-08 | Road & Parking Area Closure Segment 7 |
| SK-TC-09 | Road & Parking Area Closure Segment 8 |
| SK-TC-10 | Road & Parking Area Closure Segment 9 |

| | |
|----------|--|
| SK-TC-11 | Road & Parking Area Closure Segment 10 |
| SK-TC-12 | Road & Parking Area Closure Segment 11 |
| SK-TC-13 | Road & Parking Area Closure Segment 12 |
| SK-BF-14 | Lump Sum Bid Form |

Five sets of full scale contract drawings, maps, and specifications will be furnished to the Contractor without charge. Reference publications will not be furnished.

Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

1.5 WORK RESCHEDULING

Contractor shall allow for a maximum of 25 work days where construction activity is prohibitive due to research activities, security concerns, or special GRC activities. Further allowance for 7 days of excavation and subsurface activity abeyance shall be imposed where other construction activities are permitted. Government will provide 24 hour notification each time the restrictions are invoked.

Normal duty hours for work shall be from 7:00 a.m. to 4:30 p.m., Monday through Friday. Requests for additional work shall require written approval from the Contracting Officer 7 days in advance of the proposed work period.

1.6 OCCUPANCY OF PREMISES

Building(s) will be occupied during performance of work under this Contract. Access to buildings must be maintained by the Contractor. Access to buildings and parking areas by pedestrians and vehicles must be maintained per the Road and Parking Area Closure Plans during performance of work under this contract.

Before work is started, the Contractor shall arrange with the Contracting Officer a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, entrances, corridors, and stairways.

1.7 ON-SITE PERMITS

1.7.1 Utility Outages and Connections

Work shall be scheduled to hold outages to a minimum.

Contracting Officer may permit utility outages at his discretion.

Requests for utility outages and connections shall be made in writing to the Contracting Officer at least 5 working days in advance of the time required. Each request shall state the system involved, area involved, approximate duration of outage, and the nature of work involved.

1.7.2 Borrow, Excavation, Welding, Soil Relocation and Burn Permits

| <u>ACTIVIT</u> | <u>SUBMISSION DAT</u> |
|-----------------|-----------------------|
| Burn | 3 days prior to work |
| Excavation | 3 days prior to work |
| Welding | 3 days prior to work |
| Soil Relocation | 5 days prior to work |

Permits shall be posted at a conspicuous location in the construction area.

Burning of trash or rubbish is not permitted.

1.8 SALVAGE MATERIAL AND EQUIPMENT

Items of material designated by the Contracting Officer to be salvage shall remain the property of the Government.

It shall be segregated, itemized, delivered, and off-loaded at the Government designated storage area located within 3 kilometers of the construction site.

Contractor shall maintain property control records for material or equipment designated as salvage. Contractor's system of property control may be used if approved by the Contracting Officer. Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01315

PROJECT MEETINGS

09/96

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

A Project Submittal Schedule shall be submitted showing full coordination with the project schedule. All products and tests under each submittal number shall be prioritized and linked to the progress schedule.

SD-09 Reports

The Contractor shall submit a Weekly Progress Report at every weekly project meeting.

1.4 PRECONSTRUCTION CONFERENCE

The Contractor shall attend a preconstruction conference scheduled by the Contracting Officer. Work shall not commence prior to the conference. Subcontractor representatives may attend.

Discussion shall address project orientation, personnel contact, safety issues, permits, deficiencies, and the location of the Contractor's office.

1.5 PROJECT MEETINGS

The Contractor shall attend weekly project meetings scheduled by the Government. Subcontractor representatives shall attend if requested by the Government.

Discussion shall address the progress schedule, potential factors of delay, deficiencies, material delivery schedules, submittals, and safety issues.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01330

SUBMITTALS

09/96

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

A standard transmittal form provided by the Government shall be used to transmit each submittal.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-19, are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification.

SD-01 Data

Submittals which provide calculations, descriptions, or other documentation regarding the work.

SD-04 Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work.

SD-06 Instructions

Preprinted material describing installation of a product, system, or material, including special notices and material safety data sheets, if any concerning impedances, hazards, and safety precautions.

SD-07 Schedules

Tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

SD-08 Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other Lower Tier Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

SD-09 Reports

Reports of inspections and laboratory tests, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-13 Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

SD-14 Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

SD-18 Records

Documentation to ensure compliance with an administrative requirement or to establish an administrative mechanism.

SD-19 Operation and Maintenance Manuals

Data intended to be incorporated in an operations and maintenance manual.

1.4 PREPARATION

1.4.1 Marking

Permanent marking shall be provided on each submittal to identify it by contract number; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; specification or drawing reference; and similar information to distinguish it from other submittals. Submittal identification shall include space to receive the review action by the Contracting Officer.

1.4.2 Drawing Format

Drawing submittals shall be prepared on reproducible sheets, not less than 210 by 297 millimeter nor larger than 841 by 1189 millimeter in size,

except for full size patterns or templates. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawing reproducibles shall be suitable for microfilming and reproduction and shall be of a quality to produce clear, distinct lines and letters. Drawings shall have dark lines on a white background.

Copies of each drawing shall have the following information clearly marked thereon:

- a. Job name, which shall be the general title of the contract drawings.
- b. Date of the drawings and revisions.
- c. Name of Contractor.
- d. Name of Subcontractor.
- e. Name of the item, material, or equipment detailed thereon.
- f. Number of the submittal (e.g., first submittal, etc.) in a uniform location adjacent to the title block.
- g. Government contract number shall appear in the margin, immediately below the title block.

Drawings shall be numbered in logical sequence. Contractor may use his own number system. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block. Government contract number shall appear in the margin, immediately below the title block, for each drawing.

1.4.3 Data Format

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical. Partial submittals will not be accepted for expedition of construction effort.

1.4.4 Samples

Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range (not less than 3 units), shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

1.5 SUBMISSION REQUIREMENTS

1.5.1 Schedules

At the Preconstruction conference, the Contractor shall provide, for approval by the Contracting Officer, the following schedule of submittals:

- a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Schedule shall indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.
- b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).
- c. Submittals called for by the contract documents will be listed on one of the above schedules. If a submittal is called for but does not pertain to the contract work, the Contractor shall include it in the applicable schedule and annotate it "N/A" with a brief explanation. Approval of the schedules by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the schedules or marked "N/A".
- d. Copies of both schedules shall be re-submitted monthly annotated by the Contractor with actual submission and approval dates. When all items on a schedule have been fully approved, no further re-submittal of the schedule is required.

1.5.2 Drawings Submittals

Five blackline or blue-line opaque print(s) of each drawing shall be submitted. One print, marked with review notations by the Contracting Officer, will be returned to the Contractor.

1.5.3 Data Submittals

Five complete sets of indexed and bound product data shall be submitted. One set, marked with review notations by the Contracting Officer, will be returned to the Contractor.

1.5.4 Samples

One set of identified samples shall be submitted. A copy of the transmittal form, marked with review notations including selections by the Contracting Officer, will be returned to the Contractor.

Samples that are intended or permitted to be returned and actually incorporated in the work are so indicated in the individual technical sections. These samples will be returned to the Contractor, at his expense, to be clearly labeled, with installation location recorded. Samples shall be in undamaged condition at the time of installation.

Where mockups and similar large samples are required by individual technical sections, it is recognized that these are a special type of sample which cannot be readily "transmitted" as specified for submittal of samples. Otherwise, and except as indicated in the individual technical sections, the requirements for samples shall be complied with and a transmittal form shall be processed for each mockup, to provide a record of the activity.

1.6 GOVERNMENT'S REVIEW

1.6.1 Review Notations

Contracting Officer will review submittals and provide pertinent notation within 14 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "approved" authorize the Contractor to proceed with the work covered.
- b. Submittals marked "approved as noted" authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. Notes shall be incorporated prior to submission of the final submittal.
- c. Submittals marked "return for correction" require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.
- d. Submittals marked "not approved" or "disapproved" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes. No item of requiring a submittal shall be accomplished until the submittals are approved or approved as noted.
- e. Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes" shall be given to the Contracting Officer. Approval of the submittals by the Contracting Officer shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

- f. If changes are necessary to approved submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change shall be accomplished until the changed submittals are approved.

1.6.2 Sample Approval

Contractor shall furnish, for the approval of the Contracting Officer, samples required by the specifications or by the Contracting Officer. Shipping charges shall be paid by the Contractor. Materials or equipment requiring sample approval shall not be delivered to the site or used in the work until approved in writing by the Contracting Officer.

Each sample shall have a label indicating:

- a. Name of project
- b. Name of Contractor
- c. Material or equipment
- d. Place of origin
- e. Name of producer and brand
- f. Specification section to which samples applies
- g. Samples of furnished material shall have additional markings that will identify them under the finished schedules.

Contractor shall submit to the Contracting Officer two samples of materials where samples are requested. Contractor shall transmit with each sample a letter, original and two copies, containing the above information.

Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any contract requirements. Before submitting samples, the Contractor shall assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Materials and equipment incorporated in the work shall match the approved samples. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapproved any material or equipment which previously has proved unsatisfactory in service.

Variations from contract requirements shall be specifically pointed out in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor shall replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer shall not relieve the Contractor of his responsibilities under the contract.

1.7 PROGRESS SCHEDULE

1.7.1 Bar Chart

Contractor shall:

- a. Submit 8 copies of the progress chart, for approval by the Contracting Officer, 5 days prior to the Preconstruction Conference, in one reproducible and 7 copies.
- b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.
- c. Include no less than the following information on the progress chart:
 - (1) Break out by major headings for primary work activity.
 - (2) A line item break out under each major heading sufficient to track the progress of the work.
 - (3) A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.
 - (4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.
 - (5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.
 - (6) Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)
- d. Update the progress schedule in one reproduction and 7 copies

every week throughout the contract performance period.

1.8 STATUS REPORT ON MATERIALS ORDERS

Within 14 days after notice to proceed, the Contractor shall submit, for approval by the Contracting Officer, an initial status report on materials orders. This report will be updated and re-submitted every 7 days as the status on material orders changes.

Report shall list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

- a. Material name, supplier, and invoice number.
- b. Bar chart line item or CPM activity number affected by the order.
- c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.
- d. Current delivery date agreed on by supplier.
- e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.
- f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01411

GENERAL SAFETY REQUIREMENTS
04/97

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

CODE OF FEDERAL REGULATIONS (CFR)

| | |
|-------------|---|
| 29 CFR 1910 | (1996) Occupational Safety and Health Standards |
| 29 CFR 1926 | (1996) Safety and Health Regulations for Construction |

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-08 Statements

Statements shall be submitted for the following items in accordance with paragraphs entitled, "Safety Plan" and "Protection Plan," of this section.

Safety Plan

SD-13 Certificates

License Certificates for Radiation Materials and Equipment shall be submitted by the Contractor for all specialized material and equipment that could cause fatal harm to construction personnel or to the construction project.

SD-18 Records

Records shall be submitted in accordance with paragraph entitled, "Gas Protection," of this section.

1.3.1 Health and Safety Plan

Contractor shall submit a site specific safety plan to the Contracting Officer for approval within 15 calendar days after notice to proceed. Compliance to the safety plan will be met. NASA's site specific health and safety plan (HASP) template shall be completed by the Contractor. Copy of the approved document shall be made available at the Contractor's field office upon request from personnel working at the site. This document shall also be available to the Contracting Officer's Technical Representative and representatives of the Safety Assurance Office.

Safety plan shall include, as a minimum, the following:

- a. Safety program objectives.
- b. Methods to attain safety objectives.
- c. Responsibility of key personnel for the Contractor.
- d. Safety meetings, surveys, inspections, and reports.
- e. Disaster and emergency programs.
- f. Lists of key personnel to be contacted in times of emergency.
- g. Program to show compliance with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926.
- h. Methods to comply with the requirement for immediate reporting of accidents to the Contracting Officer.
- i. Statement that the Contractor will not invalidate the integrity of safety systems without proper authorization.
- j. Procedures for emergency actions to be taken to secure dangerous conditions, to protect personnel, and secure work areas in the event of accident or an act of nature.
- l. Procedures for securing the accident site so that the area remains secure until arrival of a safety investigator. Accident site will remain secured until released by the Contracting Officer.
- m. Provide MSDS sheets for all hazardous materials which will be used. Methods for handling and storage shall be identified.

1.3.2 Protection Plan

Structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations shall be protected against damage.

1.4 GENERAL SAFETY PROVISIONS

Contractor shall take safety and health measures in performing work under this Contract. Contractor shall meet with the Contracting Officer to develop a mutual understanding relative to administration of the safety plan. Contractor is subject to applicable federal, state, and local laws,

regulations, ordinances, codes, and orders relating to safety and health in effect on the date of this Contract.

During the performance of work under this Contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site. Contractor is responsible for his personnel and for familiarizing each of his subcontractors with safety requirements. Contractor shall advise the Contracting Officer of any special safety restriction he has established so that Government personnel can be notified of these restrictions.

1.5 SAFETY CLEARANCE PROCEDURES -- RED HOLDOFF TAG SYSTEM

Contractor shall ensure that each employee is familiar with and complies with these procedures. This procedure is more commonly called the lockout/tagout system. This procedure shall be implemented in accordance with the Glenn Safety Manual.

Contracting Officer will, at the Contractor's request, apply holdoff tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular system and equipment safe to work on.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official red holdoff tag attached to it, nor shall such tag be removed except as provided in this section.

No person shall work on any equipment that requires a holdoff tag unless he, his immediate supervisor, project leader, or a subordinate has in his possession the stubs of the required holdoff tags signifying that a system, or portion thereof, has been appropriately identified and deactivated.

When work is to be performed on electrical circuits, the work shall be performed only by personnel qualified observing the required safety clearance.

A supervisor who is required to enter an area protected by a holdoff tag is a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be red tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged,

ventilated, or otherwise made safe prior to entry.

1.5.1 Tag Placement

Tags shall be completed in accordance with the instructions printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of holdoff tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such holdoff tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

1.5.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed holdoff tag stub to the Contracting Officer. That group's or individual's holdoff tags on equipment may then be removed on authorization by the Contracting Officer.

1.6 ACCIDENT TREATMENT AND RECORDS

Contractor shall post emergency first aid and ambulance information at project site.

Contractor employees may utilize Government dispensary facilities located in Building 15 for injury and emergency medical treatment. Such treatment shall be recorded by the Contractor on form 1627, Mishap Report. Contact Safety Assurance Office. (Telephone (216) 433-8848)

1.7 FIRE PREVENTION AND PROTECTION

Open-flame heating devices will not be permitted except by approval in writing from the Contracting Officer. Approval for the granting a Hot Work Permit shall not relieve the Contractor from the responsibility for any damage incurred because of fires. Contractor shall be familiar with the requirements in the Glenn Safety Manual.

Burning trash, brush, or wood on the project site shall not be permitted.

1.8 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval shall not

relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

1.9 ELECTRICAL

Contractor shall appoint an individual responsible for the electrical safety of each work team to restrict entry to potentially dangerous locations to those authorized by him jointly with the Government.

1.10 UNDERGROUND UTILITIES

Safety clearance from the Contracting Officer is required before any Contractor personnel enters a manhole. Contractor shall contact the Contracting Officer for support services by calling (216) 433-2121 at least 24 hours in advance.

Contractor shall be responsible for removing water and debris before commencement and during execution of work in manholes.

1.11 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer.

1.12 PROTECTION OF WORK

Prior to performing any excavation work or any surface penetrations 150 millimeter or deeper (such as driving stakes more than 150 millimeter in the ground) on any ground surface, the Contractor shall obtain from the COTR the current subsurface utility drawing of the particular area to be worked on. Contractor shall stake out subsurface high voltage cables, communication cables, and pipe lines indicated within the scope of the work contemplated. After exposure, the Contractor shall obtain agreement from the Contracting Officer on how much closer to cable or pipe the excavations can be permitted.

Contractor shall notify the Contracting Officer, 48 hours prior to the start of excavation work or surface penetration, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and possible damage to subsurface utilities. Where emergency conditions preclude the 48 hours advance notification, the Contractor shall immediately inform the Contracting Officer of his intention to initiate work prior to actual start of activity.

After obtaining clearance from the Contracting Officer, the Contractor shall proceed with excavating work, or other surface penetration work. Contractor, however, shall temporarily halt any machine excavation work or other surface penetration when approaching within 3 meter of the staked-out

cable or pipe line until the Contractor has exposed the cable or pipe by hand excavation to fix its location.

1.13 GAS PROTECTION

Contractor shall have one or more employees properly trained in operation of gas testing equipment and formally qualified as gas inspectors who shall be on duty during times workmen are in confined spaces. Their primary functions shall be to test for gas and operate testing equipment. Unless equipment of constant supervisory type with automatic alarm is employed, gas tests shall be made at least every 2 hours or more often when character of ground or experience indicates gas may be encountered. A gas test shall be made before workmen are permitted to enter the excavation after an idle period exceeding one-half hour.

Readings shall be recorded daily, indicating the concentration of gas, number and location of drilled piers, point of test, date, and time of test.

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A check by Glenn Safety Office, First Responders is required prior to entering confined space. Surveillance and monitoring shall be required in these types of work spaces by both Contractor and Government personnel.

1.14 ROOFING AND COATING

At the beginning of each work day the Contractor shall check with the Contracting Officer before proceeding to work on the roof to ensure safe work conditions.

1.15 WELDING, FLAME CUTTING, AND MELTING

Contractor shall obtain approval for welding and cutting operations with the Contracting Officer before operations begin.

Contractor shall discontinue burning, welding, or cutting operations 1 hour prior to the end of the normal work day. A workman shall remain at the site for 1 hour after discontinuing these operations to make thorough inspection of the area for possible sources of latent combustion. He shall be equipped with two full 6.8 kilogram carbon dioxide fire extinguishers. Any unsafe conditions shall be reported to the Safety Assurance Office. (Telephone: (216) 433-8848)

During operations involving possible fire hazard, the Contractor shall notify the Contracting Officer and not proceed until a Hot Flame Permit is approved. Contracting Officer may request a standby from the Fire Station. This requirement does not relieve the Contractor of his responsibility for welding and cutting safety.

1.16 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and

explosive device activated tools) shall be scheduled during the hours 8:00 a.m. to 5:00 p.m. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work.

The Contractor shall comply with 29 CFR 1910.95, the OSHA standard on Occupational Noise Exposure. In addition, employees of the Contractor and its subcontractors shall wear personal hearing protection when exposed to noise that exceeds 85 dB(A) TWA, regardless of the intended or actual duration of exposure. The Contractor shall provide all employees and subcontractors assigned to this project with personal hearing protection, which shall have a Noise Reduction Rating (NRR) sufficient to reduce noise to a maximum of 85 dB(A), determined per OSHA methods. This requirement shall apply to continuous, intermittent, and impact noise that is generated by any NASA or Contractor-owned equipment or facility. The Contractor shall be responsible for enforcing the compliance of all employees and subcontractors.

The Contractor shall provide personal hearing protection sufficient to reduce noise to a maximum of 85 dB(A).

It is the Contractor's responsibility to monitor noise levels of its own operations for the purpose of determining personal hearing protection requirements. NASA will provide LeRC facility noise level information on request. Personal hearing protection requirements shall be determined on the basis of the highest noise level to which employees can reasonably be expected to be exposed.

Contractors working outdoors or in buildings known to have high noise operations shall have personal hearing protection equipment on their person at all times.

Contractor health and safety plans shall indicate personal hearing protection selections, including NRR, and any administrative controls that will be implemented to meet the default 85 dB(A) (TWA) noise exposure limit.

1.17 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor shall:

- a. Secure outside equipment and materials and place materials possible to damage in protected locations.
- b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
- c. Ensure that temporary erosion controls are adequate.

1.18 HAZARDOUS WASTE

Contractor shall identify all wastes produced and dispose of them in the following approved manners and in accordance with Section 01104:

Identify all wastes and waste producing processes including chemicals,

paints, define products and solvents, and their containers. Unknown wastes will be chemically identified by the Government.

Obtain a determination of whether the waste is hazardous from the Contracting Officer.

Notify the Contracting Officer prior to taking disposal action for any hazardous waste.

For disposal, provide either laboratory analysis data documenting the chemical content of the waste or certification by appropriate organization authority as to the chemical constituents of the waste. Technical assistance on disposal analysis requirements will be provided on request by contacting the Contracting Officer.

Document the waste type, quantity, location, and personnel/contractor/agency responsible so the material can be tracked from generation through ultimate disposal as required by Environmental Protection Agency under Resource Conservation and Recovery Act.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01450

QUALITY CONTROL
09/99

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-06 Test Reports

Contractor shall submit the following items in accordance with the paragraph entitled, "Records," of this section.

Quality Control Data
Quality Control Coordinating Actions
Quality Control Training
Inspection Records
Letters of Authority or Delegation
Field Tests

SD-07 Certificates

Contractor shall submit a detailed written statement describing procedures that will be implemented to achieve quality on the project according to the paragraph entitled, "Quality Assurance (QA) Plan," of this section.

Contractor shall submit the following in accordance with the paragraph entitled, "Qualifications," of this section.

Contractor's Quality Representative Qualifications
Special Certifications

1.3.1 Quality Assurance (QA) Plan

QA plan shall address the following:

Description of the authority, responsibilities and coordinating procedures, of on-site/off-site quality assurance personnel, including those QA personnel not under direct control of the Contractor.

QA plan shall list personnel designated by the Contractor to accomplish the work required by the contract.

QA plan shall also contain an appendix with a copy of each form, report format, or similar record to be used in the QA program.

Contractor's organization that handles construction contract activities.

Contractor's operational plan for accomplishing and reviewing work controls, fabrication controls, certifications, and documentation of quality control operations, inspections, and test records, including those for subcontractors.

These provisions shall include the methods to be used during the procurement cycle (order to delivery) for those materials or equipment that require source inspections, shop fabrications, or similar operations located separately from the work site.

Description of on-site personnel training.

Certification(s) of personnel, procedures, processes, and equipment.

Nondestructive testing requirements.

Identification of independent certifying and testing laboratories.

1.3.2 Records

Records shall include all quality control data; factory tests or manufacturer's certifications, quality control coordinating actions; records of quality control training/certifications as well as routine hydrostatic, electrical continuity, grounding, welding, line cleaning, field tests and similar tests. Quality records shall be available for examination by the Contracting Officer.

Legible copies of the test and inspection records shall be furnished to the Contracting Officer. Records shall cover work placement traceable to the contract schedule, specifications and drawings, and shall be verified by the Contractor.

Contractor shall submit for approval, the narrative description of an inspection system which provides for compliance with the quality requirements and technical criteria of the contract within 7 days after notice to proceed.

Contractor shall submit a monthly performance report that summarizes the quality operations. This report shall identify inspections made, tests performed, nonconformances, corrective actions taken, status of plans/procedures being developed, and status of open items/problems in work.

Contractor shall submit Letters of Authority or Delegation outlining the authority and responsibilities of quality control personnel along with a copy of the letter of delegation to the Contracting Officer that defines delegated duties and responsibilities.

In-process inspection records and control away from the job site may be used as evidence of quality of materials/work and may reduce further inspection or testing after delivery to the job site.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor's Quality Representative Qualifications shall be submitted to the Contracting Officer for approval. Quality Representative may be assigned to more than one contract provided that the assigned contracts are located at the same site.

When approval or certification of special processes, operating personnel, and special equipment or procedures is required by the specifications, the Contractor shall obtain necessary approvals or special certifications prior to starting the work.

1.4.2 Quality Control Requirements

Contractor shall provide a quality control program encompassing: selection of construction materials and sources; suppliers; subcontractors; on-site and off-site fabrication of Contractor-furnished assemblies; on-site and off-site assembly; erection; work procedures; workmanship; inspection; and testing.

Contractor's program shall provide document systems ensuring that quality provisions of contract schedule, specifications, and drawings have been performed.

1.4.2.1 Management and Organization

Contractor shall designate an individual within the on-site organization whose sole responsibility shall be the day-to-day on-site management and direction of the Quality Program.

The Quality Program Manager shall report to the Contractor's management and shall have the necessary authority to discharge contractual responsibilities.

1.4.2.2 Identification and Data Retrieval

Contractor shall have an identification and data retrieval system.

Records, drawings, submittals, and equipment shall be identified by referencing the Contract Number; Contract Specification Number; Contract Drawing Number; Submittal Document Number; Contract Change Number; and the Contractor's Drawing Number System.

1.4.2.3 Procurement

Contractor shall be responsible for controlling procurement sources and those of his subcontractors to ensure that each purchase meets quality

requirements.

1.4.2.4 Receiving Inspection System

Contractor shall maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Receiving inspection records shall accompany each procurement delivery to the construction site. Records of site receiving inspections shall be maintained by the Contractor.

Records shall show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection.

1.4.2.5 Nonconforming Articles and Material Control

The Contractor shall control nonconformances discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to correct deficient operations.

- a. Contractor shall prepare a "nonconformance" report for each instance comprising:
 - (1) A unique and traceable number.
 - (2) Identification of the nonconforming article or material.
 - (3) A description of the nonconformance and the applicable requirement.
 - (4) Cause or reason for the nonconformance.
 - (5) Remedial actions taken or recommended.
 - (6) Disposition of the nonconforming article or material.
- b. The Contractor shall identify and mark each nonconforming article for removal from the work area.
- c. The Contractor shall monitor and correct deficient operations.

1.4.2.6 Fabrication, Process, and Work Control

Contractor's procedures and controls shall ensure compliance with requirements in contract specifications and drawings.

Contractor shall establish in-process inspections, to ensure compliance with quality requirements.

1.4.2.7 Quality Control Records

Quality control records shall be maintained at a central on-site location.

Maintenance of quality control records shall not relieve the Contractor

from submitting samples, test data, detail drawings, material certificates, or other information required by each section in the specification.

Contractor shall ensure each record is identified and traceable to specific requirements in the specifications and drawings.

1.4.2.8 Drawings and Change Control

Drawing-control system shall be maintained to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Changes involving interface with other work areas, or affecting materials controlled by others shall be controlled by the Contractor. This system shall be integrated with the document requirements of the contract.

Drawing changes shall be clearly annotated. Implemented changes shall be clearly identified and associated drawings shall be revised accordingly. Drawings that have been approved, or approved as noted, by the Contracting Officer shall be used for fabrication and inspection.

1.4.3 Quality Inspections

1.4.3.1 Government Inspections

Work performed under this contract will be subject to inspection by the Contracting Officer. Changes to the specifications or drawings will not be allowed without written authorization of the Contracting Officer.

When the Contracting Officer determines that inspected work needs to be corrected, the Contracting Officer will be allowed 24 hours to complete reinspection of the corrected work.

Contracting Officer shall also be notified in writing before backfilling or encasing any underground utility so that work may be inspected. Failure to notify the Contracting Officer before backfill or encasement occurs shall require the work be uncovered at no additional cost to the Government.

Contractor's program is subject to continuous evaluation, review, and verification by the Contracting Officer. Contractor will be notified in writing of any noncompliance and will be given 5 days to correct identified deficiencies.

1.4.3.2 Contractor's Quality Inspections

Contractor shall implement an inspection system. Documentation shall indicate quality control through records of inspections, tests, and procedures.

Contractor's quality assurance system shall include the following:

- a. Single Contractor's representative responsible for on-site communication and operation of the inspection program.
- b. Purchasing control system documenting project procurement to drawings, specifications, and approved submittals.

- c. Receiving inspection system documenting inspections for each procurement.
- d. Documentation for handling and disposing of nonconforming components and materials.
- e. Inspection records for each specific section of the specification and drawings.
- f. Identification of test(s) to be performed, test procedures, records, and independent organizations used.
- g. Documenting and maintaining certification or re-certification of procedures.
- h. Management of government-furnished equipment, components, and materials.
- i. Calibration of gages, tools, measuring instruments, and independent laboratories used.

Contractor shall establish a system of scheduled or random audits to ensure task completion.

1.4.4 Field Services

1.4.4.1 Responsibility for Inspection and Testing

Contractor shall be responsible for all inspections and tests, and the accompanying documentation for each inspection and test. Contractor may utilize independent inspection and testing laboratories or services as approved by the Contracting Officer.

Contractor shall also be responsible for tests of construction materials utilizing the services of an approved independent testing laboratory.

1.4.4.2 Inspection and Test Records

Contractor shall provide on-site records of each inspection and test performed throughout the life of the contract. Records shall include, but not be limited to, factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, identification of operators and inspectors, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Inspection records, test procedures, test results, and associated forms will be verified by the Contracting Officer.

1.5 HANDLING AND STORAGE

Contractor shall provide controls, procedures and documentation with each shipment, that meet requirements of each section of the specifications.

The Contractor shall include documentation with each shipment. The data shall consist of documentation required by the contract along with specifications required to identify, store, preserve, operate, and maintain the items shipped.

1.6 SEQUENCING AND SCHEDULING

Contractor shall notify the Government at least 24 hours prior to scheduled inspections and tests.

Contractor shall provide 24 hours notice to the Government of the date when the contract work will begin at the site.

When Contractor suspends work for 1 day or longer prior to completion, the Contracting Officer shall be notified. Work shall not resume without notification of the Contracting Officer.

Contracting Officer shall be notified at least 2 hours in advance of backfilling or encasing any underground utility.

1.7 LAYOUT AND QUALITY CONTROL MEASUREMENTS FOR UNDERGROUND UTILITIES

A Professional Surveyor registered in the State of Ohio shall perform all construction layout and quality control measurements for underground utilities. Layout shall be performed in metric dimensions and be accurate enough to achieve the construction tolerances. The Contractor shall provide copies of the Surveyor's field book to the COTR. The Contractor shall not employ a Surveyor or his firm who is the current NASA GRC Support Service Contractor.

1.8 CONSTRUCTION TOLERANCES AND QUALITY CONTROL FOR SEWERS

Sewer invert elevations shall be constructed to within 30 millimeters of the elevation required by the contract drawings. Manholes shall be located horizontally within plus or minus 180 millimeters of the location on the contract drawings. The Contractor shall construct the sewer between two manholes within 5 percent of the percent grade stated on the construction drawings. The most stringent requirement shall apply.

1.9 NASA QUALITY ASSURANCE MEASUREMENTS FOR UNDERGROUND UTILITIES

During the construction, the Contractor shall allow and make provisions for NASA to survey the work in progress. The Contractor shall provide access for the NASA GRC support service contractor's surveyor to enter the construction site, set up survey instruments, and take measurements. The purpose of these measurements is to perform quality assurance measurements for the location and elevation of the installed sewer and manholes. The Contractor remains responsible to perform quality control measurements throughout construction as required.

1.10 AS-BUILT SURVEY FOR UNDERGROUND UTILITIES

The Contractor shall provide the COTR with copies of the Surveyor's field

book recording the measurements of the installed locations, invert elevations, and the deviations from the construction drawings of manholes. The Surveyor shall also record his measurements on the as-built set of drawings and record the date of surveys.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS
09/96

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component of, each section of the specifications.

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

FEDERAL AVIATION ASSOCIATION (FAA)

FAA AC 70/7460-1 (Rev H; Change 1 - 2) Obstruction Marking
and Lighting

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT 614 (1997) Maintaining Traffic; and Subparts
as Specified

1.3 SUBMITTALS (Not Applicable)

PART 2 PRODUCTS

2.1 CONSTRUCTION SIGN

Contractor shall provide a construction identification sign.

Sign shall comprise a face sheet of 1200 by 2400 millimeter exterior grade plywood, 13 millimeter thick, mounted on a substantial frame of treated lumber. Frame and sign shall be given one coat of lead-free alkyd primer paint and two coats of an exterior type white enamel.

2.2 CONSTRUCTION DETAILS

Lettering and further details of construction shall be in accordance with the drawings.

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES

Contractor shall provide temporary utilities required for construction. Materials may be new or used, shall be adequate for the required usage,

shall not create unsafe conditions, and shall not violate applicable codes and standards.

Contractor shall provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 30 meter above ground level. Light construction and installation shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer.

3.1.1 Electricity

Contractor shall provide connections, sized to provide service required for power and lighting. Feeder and branch wiring with area distribution boxes shall be located so that power is available throughout the project site by use of power cords. 120/240 electrical volt feeder service is available. Lighting shall be provided by the Contractor. Electricity used will be furnished by the Government.

3.1.2 Water

Contractor shall make connections to existing facilities to provide water for construction purposes. Water used will be furnished by the Government.

3.1.3 Telephone Service

Contractor shall provide telephone service. Contractor shall pay costs of installation and service.

3.1.4 Sanitary Facilities

Contractor shall provide temporary sanitary facilities and shall service, clean, and maintain these facilities and enclosures. Temporary facilities shall be removed from the site at the completion of the work.

3.1.5 Fire Protection

Contractor shall provide temporary fire protection equipment for the protection of personnel and property during construction. Debris and flammable materials shall be removed weekly to minimize potential hazards.

3.2 SIGNS

3.2.1 Construction Sign

Within 30 days after notice to proceed, the Contractor shall install the construction identification sign at the location designated by the Contracting Officer.

3.2.2 Other Signs and Advertisements

Only signs necessary to expedite deliveries, maintain traffic flow, promote safety (e.g. caution, danger, blasting, hardhat area), and prevent interference with Government operations shall be erected.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

Contractor shall conduct his operations in a manner that will not close any thoroughfare or interfere in any way with traffic on roads, driveways, or walks except according to the road closure plan or the written permission of the Contracting Officer. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

Work shall be conducted so as to minimize obstruction of traffic, and traffic shall be maintained on at least half of the roadway width at all times. Approval shall be obtained from the Contracting Officer prior to starting any activity that will obstruct traffic.

Contractor shall provide, erect, and maintain, at his own expense, lights, barriers, signals, passageways, detours, etc., that may be required.

The installation, maintenance, and operation of all traffic controls and traffic control devices shall conform to the requirements of the Ohio Manual of Uniform Traffic Control Devices and shall conform to ODOT 614. Temporary pavement markings, traffic signs, and channelizing devices will be required.

The contractor shall provide a traffic control plan, i.e. barricades, signs and pavement markings to the COTR for approval at least 10 days prior to use. Shop drawings shall be submitted for all pedestrian crossings for approval by the COTR prior to installation and use. Necessary protective devices, flashers, barricades or other traffic control devices shall be provided to insure proper channelization of vehicles. All such crossings shall meet local, State and Federal codes and law.

Temporary pedestrian crossings shall be provided in areas as shown on the plans or as may be directed by the COTR. Each crossing provided shall be designed for a minimum 80 psf live loading. Protective railings shall be provided as part of the structure; minimum width of travelled part shall be 4 feet. Shop drawings of all crossings shall be submitted for approval to the COTR prior to installation and use.

Closings of pedestrian walkways or sidewalks due to excavation or other work shall be limited to total duration of 24 hours, at any one location, except at locations where the trench runs parallel to and directly below the walkway or sidewalk. The walkway or sidewalk will be considered opened when the installation of a temporary crossing in accordance with the specifications and drawings is complete.

3.3.2 Site Cleanup and Dust Control Methods

It is the Contractor's responsibility to keep the work site clean of trash and construction debris. All dirt, mud, and stone left on roadways to and from the work site shall be broomed off and removed each day, and if necessary roadways shall be washed down after the broom operation. In addition, all materials stored at the work site shall be stored and

stockpiled in a neat and safe manner.

Contractor's dust control methods and procedures shall be approved by the Contracting Officer. Dust abatement on access roads shall be treated with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.4 TEMPORARY STRUCTURES

Contractor-owned or -leased trailers shall be identified by Government assigned numbers. Required number shall be furnished by the Government. Size and location of the number shall be approved by the COTR. Contractor shall apply the number to the trailer within 14 days of notification, or sooner, if directed by the Government.

3.5 PROTECTION OF EXISTING SYSTEMS

3.5.1 Utility

Connection to existing utilities, identified on the drawings to the Contractor, shall be protected from damage during construction activity.

3.5.2 Safety

Contractor shall protect the integrity of any installed safety systems or personnel safety devices.

If entrance into systems serving safety devices is required, the Contractor shall obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, the Contractor shall provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and shall obtain prior approval from the Contracting Officer.

3.6 DRAINAGE AND EROSION CONTROL

Contractor shall submit 3 copies of the proposed construction plan addressing erosion, sediment and drainage control to the COTR and to the Government. Agency's written approval shall be obtained and submitted to the Contracting Officer prior to commencement of work.

-- End of Section --

SECTION 01780

CLOSEOUT SUBMITTALS
09/96

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Spare Parts Data shall indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

SD-04 Drawings

As-Built Drawings shall be submitted under the following criteria:

In order to minimize the time for final payment at the completion of the project, the Contractor shall update the as-built drawings every month with the Contracting Officer's authorized representative. This update will be a part of "the monthly request for payment meeting," and payment--or a portion of the payment, including final payment--may be withheld until the as-built drawings have been updated, and accepted by the Contracting Officer. All invert elevations and horizontal coordinates must be recorded on the as-built drawings by a Registered Professional Surveyor.

After completion of all construction and before final payment is made under this contract, the Contractor shall provide the Contracting Officer with one complete set of full size blue line contract drawings with alterations shown in red pencil.

SD-06 Instructions

Preventative Maintenance and Inspection schedules shall be submitted by the Contractor with instructions that state when systems should be retested.

Schedule shall define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements. Each test feature; e.g., liter per second, rpm, kilopascal, shall have a signoff blank for the Contractor and Contracting Officer. A remarks column of the testing validation procedure shall include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair shall be delineated.

Repair requirements shall inform operators how to check out, troubleshoot, repair, and replace components of the system. Instructions shall include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

SD-06 Instructions

Posted Instructions shall be submitted by the Contractor with labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

SD-08 Statements

A Work Plan shall be submitted to the Contracting Officer for project closeout. Plan shall include all scheduled inspections, instruction classes, items, closeout dates for all functions, and shall list the required Government and Contractor personnel that will be taking part in these functions.

SD-18 Records

Three reproducible copy(s) of each drawing, product data record, or log shall be submitted for historical record.

Final drawings shall incorporate contract changes and plan deviations. Lines, letters, and details will be sharp, clear, and legible. Additions or corrections to the drawings will be drawn to the scale of the original drawing. One copy, marked with review notations by the Contracting Officer, will be returned to the Contractor. Drawings are to be resubmitted within 14 calendar days after the completion of the representative work effort.

Documents shall be current. Contractor shall not conceal record information until as-built drawings have been made. Record drawings shall be submitted with a transmittal letter containing date, project title, Contractor's name and address, document list, and Contractor's signature.

Reproducible Drawings
CAD System Drawings

SD-19 Operation and Maintenance Manuals

Contractor shall submit 6 copies of the project operation and maintenance manuals 30 days prior to testing the system involved. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Operation and Maintenance Manuals shall be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Information shall be bound in manual format and grouped by technical sections. Test data shall be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals shall have 10 millimeter holes and be bound in 3-ring, loose-leaf binders. Data shall be organized by separate index and tabbed sheets, in a loose-leaf binder. Binder shall lie flat with printed sheets that are easy to read. Caution and warning indications shall be clearly labeled.

Contractor shall submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services shall be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. Contracting Officer shall be given 7 days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, shall be made available to the Contracting Officer.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 02220

DEMOLITION
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 180 (1993) Standard Method of Test for
Moisture-Density Relations of Soils Using
a 10-lb (4.54 kg) Rammer and an 18-In.
(457 mm) Drop

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330,
"Submittals," in sufficient detail to show full compliance with the
specification:

SD-08 Statements

Contractor shall prepare and submit a detailed Demolition Plan of
the work procedures and safety precautions to be used in the
identification, demolition, handling, removal, transportation, and
reclamation or disposal of removed materials. Contractor shall
meet with the Contracting Officer, prior to beginning work, to
discuss in detail the demolition plan.

SD-18 Records

Existing Conditions shall be recorded in the presence of the
Contracting Officer showing the condition of structures and other
facilities adjacent to areas of alteration or removal. Such
record shall contain the elevation of the top of foundation walls,
the location and extent of cracks and other damage and description
of surface conditions that exist prior to the start of work.
Copies of the record shall be submitted and the stated conditions
before starting work shall be verified.

SD-18 Records

Written approval by the Contracting Officer for Interruption of
the following shall be submitted at least 48 hours prior to work:

Utility Outages
Traffic Interruptions

PART 2 PRODUCTS

2.1 FILL MATERIAL

Fill material shall be as per contract drawings.

PART 3 EXECUTION

3.1 DISCONNECTING EXISTING UTILITIES

Prior to the start of work, utilities serving each area of alteration or removal, the Contractor shall install temporary utility service.

3.2 TEMPORARY UTILITY SERVICES

The Contractor shall install temporary utility services before disconnecting existing utilities. The Contractor shall maintain the temporary services during the period of construction and remove only after permanent services have been installed, tested, and are placed in-service.

3.3 PRECAUTION AGAINST MOVEMENT

Contractor shall provide shoring and bracing or other supports to prevent movement, settlement, or collapse of facilities adjacent to areas of alteration and removal that are to remain.

3.4 DEMOLITION AND REMOVAL WORK

3.4.1 Demolition

3.4.1.1 Concurrent Earth-Moving Operations

Excavation, filling, and other earth-moving operations that are sequential to demolition work shall not be started in areas occupied by structures to be demolished until all demolition in the area has been completed and debris has been removed.

3.4.1.2 Oil/Water Separator and Septic Tank Removal

The Contractor shall take the oil/water separators (OWS) out of service prior to removal. To take the OWS by the Low Pressure Fuel Pumping Station (LPFPS), Site 91, out of service, the Contractor shall temporarily plug the inlets at the LPFPS, which flow into the OWS and provide an automatic pump to empty the LPFPS into the industrial waste sewer. To take the OWS serving Building 24, Special Project Laboratory, out of service, the Contractor shall complete the installation of the sanitary sewer to manhole 484. The septic tank is out of service.

As soon as the OWS are taken out of service, the Contractor shall notify the COTR and the GRC Environmental Management Office's Waste Management Team (WMT) at 433-5109 to request the WMT to remove the liquid and sludge of the OWS and/or septic tank. The Contractor shall allow a period of twenty (20) NASA business days for WMT to sample and dispose of the

contents. The WMT will obtain the services of a Waste Disposal Contractor to remove the contents of the OWS and/or septic tank, and to provide roll-off boxes at a location to be determined by the COTR and the Contractor.

The Contractor shall use the roll-off boxes to contain the excavated OWS and/or septic tank and the surrounding soil. Excavation shall be kept to the minimum necessary to remove the existing OWS, septic tank and install the new OWS at the Low Pressure Fuel Pumping Station, Site 91.

The oil/water separators and/or septic tank shall be completely removed by the Contractor and disposed of into the roll-off boxes provided by NASA.

When the Contractor completes the excavation, he shall notify the COTR to make arrangements with the WMT to sample and dispose of the contents of the roll-off boxes.

The excavated areas shall be backfilled and the areas restored.

3.4.1.3 Filling Voids

Voids resulting from the demolition of structures shall be completely filled as per contract drawings, and graded.

Prior to filling, voids shall be free of standing water, frost, frozen material, trash, and debris.

Fill material shall be placed in horizontal layers not to exceed 200 millimeter in loose depth. Each layer shall be compacted to a minimum of 90 percent of the maximum density as determined by AASHTO T 180, Method D, at optimum moisture content.

After fill has been placed, the surface of the fill shall be graded to meet adjacent contours and to provide surface water drainage.

3.4.2 Protective Measures

Existing construction shall not be disturbed beyond that indicated or necessary for installation of new work. Temporary shoring and bracing shall be provided for support of building components to prevent settlement or other movement.

Protective measures shall be provided to control accumulation and migration of dust and dirt in all areas of work. Dust, dirt, and debris shall be removed from the areas of work daily.

3.4.3 Salvageable Materials and Equipment

Government will designate materials and equipment to be salvaged.

Salvageable materials and equipment shall be removed in a manner that will cause the least possible damage thereto. Contractor personnel shall handle, store, and protect removed items that are to be reused in the work or are to be retained by the Government.

Identification tags shall be provided on items boxed or placed in containers, indicating the type, size, and quantity of materials.

3.4.4 Scrap Metal

Scrap metal shall become the Contractor's property and shall be removed from the site as it accumulates.

3.4.5 Site Work

Chain-link fencing, gates, and other salvaged items shall be removed and stored. Gates shall be removed as whole units. Chain link fabric shall be cut to lengths of 7 meters and stored in rolls off the ground.

3.4.6 Buildings and Structures

Specified removal operations shall be performed in existing buildings as required to complete the work.

Concrete:

Existing concrete shall be demolished, removed, and disposed of. Square, straight edges shall be provided where existing concrete adjoins new work and other locations. Existing steel reinforcement shall be protected where indicated; otherwise, it shall be cut off flush with face of concrete.

Masonry:

All masonry construction shall be demolished and removed.

Masonry units for reuse shall be removed, cleaned, and stacked off the ground on wood pallets. Salvaged masonry units not reused in the work shall remain the property of the Government. Damaged units unsuitable for reuse shall be considered as debris and shall be disposed.

Structural steel:

Structural steel components shall be dismantled at field connections and in a manner that will prevent bending or damage.

Flame-cutting torches shall not be used.

Trusses and joists shall be transported as whole units and not dismantled.

Structural steel shall be transported to designated storage area, stacked according to size, type of member and length, and stored off the ground and protected from the weather.

Miscellaneous metals:

Shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, and similar items shall be salvaged as whole units.

Light-gage metal items, such as metal gutters, roofing and siding, and similar items, shall be salvaged unless designated as scrap metal.

Carpentry:

Lumber, millwork items, and finished boards, except those that are unfit for reuse, shall be salvaged.

Windows, doors and frames, and similar items shall be removed as units, complete with trim and accessories. Hardware shall be left intact and attached to units, except that door closers shall be removed. Open end of door frames shall be braced to prevent damage thereto.

Gypsum board, fiberboard, and other composition sheathing boards shall be classified as debris to be removed and disposed of.

Demountable partitions, built-in furniture, toilet partitions, lockers, and other prefabricated units shall be removed in sections and salvaged.

Bolts, nuts, washers, timber connectors, and other rough hardware shall be classified as debris and disposed of.

Miscellaneous items:

Chalkboards, tackboards, toilet-room accessories, and similar surface-mounted items shall be removed and salvaged as whole units, complete with all accessories.

Venetian blinds, complete with hardware items which shall be packaged and attached thereto, shall be removed and salvaged.

3.4.7 Mechanical Equipment and Fixtures

Mechanical hardware shall be disconnected at the nearest convenient connection to existing services that are to remain.

Each item of equipment and fixtures shall be salvaged as a unit; listed, indexed, tagged, and stored. Each unit shall be salvaged with its normal operating auxiliary equipment.

Equipment shall not be removed until approved.

Disconnection from utilities:

Mechanical equipment and fixtures shall be disconnected at fittings. Service valves shall be removed and attached to the unit.

Preparation for storage:

Water, dirt, dust, and foreign matter shall be removed from units; tanks, piping and fixtures shall be drained; and interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Openings shall be sealed with caps, plates, or plugs.

Motors attached by flexible connections shall be secured to the unit.

Lubricating systems shall be charged with the proper oil or grease.

Piping:

Piping shall be disconnected at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Salvaged piping shall be stored according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control.

Piping that previously contained gas, gasoline, oil, or other dangerous fluids shall be carefully dismantled, with precautions taken to prevent injury to persons and property. Such piping shall be stored outdoors until all fumes and residues are removed.

Prefabricated supports, hangers, plates, valves, and specialty items shall be boxed according to size and type. Sprinkler heads shall be individually wrapped in plastic bags before boxing.

Piping not designated for salvage, or not reusable, shall be considered as scrap metal.

Ducts:

Removed duct work shall be classified as scrap metal.

Fixtures:

Fixtures associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations shall be removed and salvaged. Fixture units shall be tagged for identification, storage, and protection from damage.

Broken, damaged, or otherwise unserviceable units shall be classified as debris and disposed of by the Contractor.

Motor and machines:

Motors and machinery items associated with the plumbing, heating,

air conditioning, refrigeration, and other mechanical system installations shall be removed and salvaged. Auxiliary units and accessories shall be salvaged and boxed and stored with the main unit.

Such items shall be tagged for identification, stored, and protected from damage.

3.4.8 Electrical Equipment and Fixtures

Motors, motor controllers, and operating and control equipment shall be salvaged and attached to the driven equipment.

Wiring systems and components shall be salvaged. Loose items shall be boxed and tagged for identification.

Primary, secondary, control, communication, and signal circuits shall be disconnected at the point of attachment to their distribution system.

Fixtures:

Electrical fixtures shall be removed and salvaged. Unprotected glassware shall be removed from the fixture and salvaged separately.

Incandescent lamps, mercury-vapor lamps, and fluorescent lamps shall be salvaged, boxed and tagged for identification, and protected from breakage.

Electrical devices:

Switches, receptacles, switchgear, transformers, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items shall be removed and salvaged. These items shall be boxed and tagged for identification according to type and size.

Conductors:

Conductors, including insulated wire and nonmetallic sheathed and flexible armored cable, shall be removed and salvaged.

Conduit:

Conduit, except where embedded in concrete or masonry, shall be salvaged. Corroded, bent, or damaged conduit shall be considered as scrap metal. Straight, undamaged lengths shall be sorted and stockpiled according to size and type.

Wiring ducts or troughs:

Wiring ducts or troughs shall be removed and salvaged. Plug-in ducts and wiring troughs shall be disassembled into unit lengths. Plug-in or disconnecting devices shall be removed from the busway

and stored separately.

Miscellaneous items:

Supports, knobs, tubes, cleats, and straps shall be classified as debris to be removed and disposed.

3.4.9 Elevators and Hoists

Elevators, hoists, and similar conveying equipment shall be removed and salvaged as whole units, to the most practical extent. Items shall be removed and prepared for salvage without damage to any of the various parts.

Rails for structural steel shall be salvaged and stored with the equipment as an integral part of the unit.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 General

Debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations shall be disposed of in accordance with all applicable federal, state and local regulations as contractually specified off the Lewis Center. Removed materials shall not be stored on the project site.

3.5.2 Burning on Government Property

Burning of materials removed from demolished structures will not be permitted on Government property.

3.5.3 Removal from Government Property

Waste materials removed from demolished structures, except waste soil, shall be transported from Government property and legally disposed. Waste soil shall be disposed of as directed.

-- End of Section --

SECTION 02225

EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES

07/94

PART 1 GENERAL

1.1 SUMMARY

The work under this section consists of all labor, services, materials, equipment, tools and testing services necessary to excavate and backfill for the underground utility work detailed on the Contract drawings. The work includes removal of concrete pavement and base, removal of asphalt pavement and base, removal and stockpiling of topsoil, pit excavation, trench excavation, disposal of excavated soil, disposal of contaminated soil, stockpiling of excavated soil for re-use as fill, placement of granular bedding material, backfill and compaction of stockpiled soil, backfill and compaction with granular material, backfill with low strength mortar backfill, protection of existing utility lines, and temporary excavation shoring.

1.2 REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS (AASHTO) AND TRANSPORTATION

- | | |
|--------------|---|
| AASHTO M 145 | (1991) Recommended Practice for the Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes |
| AASHTO T 180 | (1993) Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-In. (457 mm) Drop |
| AASHTO T 2 | (1991) Standard Methods of Sampling of Aggregates |
| AASHTO T 87 | (1986; Rev 1993) Standard Method for the Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|--|
| ASTM C 136 | (1995; Rev A) Standard Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM D 1556 | (1990) Standard Test Method for Density of Soil in Place by the Sand-Cone Method |
| ASTM D 2922 | (1991) Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |

ASTM D 3740 (1994) Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction

ASTM D 422 (1963; R 1990) Standard Test Method for Particle-Size Analysis of Soils

ASTM D 4318 (1995) Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1 (1991) All Timber Products - Preservative Treatment by Pressure Processes

AWPA C3 (1991) Piles - Preservative Treatment by Pressure Processes

CODE OF FEDERAL REGULATIONS (CFR)

CFR 29 Part 1926, SUBPART P Excavation, Trenching, and Shoring

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT 203 (1997) Roadway Excavation and Embankment; and Subparts as Specified

ODOT 499 (1997) Concrete, General; and Subparts as Specified

ODOT 603 (1997) Pipe Culverts, Sewers and Drains; and Subparts as Specified

ODOT 604 (1997) Manholes, Catch Basins, Inlets, Inspection Wells, Junction Chambers or Monuments; and Subparts as Specified

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-04, Drawings

As-Built Drawings shall be submitted in accordance with Section 01780, "Contract Closeout".

SD-07, Schedules

Construction Equipment List of all major equipment to be used shall be submitted by the Contractor prior to commencing

construction.

SD-08, Statements

Demolition Plan shall be approved by the COTR at least 48 hours in advance of the work. The plan will include all special environmental considerations and safety precautions along with the coordination procedures for the protection plan and work plan of this phase of the work.

SD-08, Statements

Work Plan shall be submitted including proposed methods of excavation, shoring of excavation sides, coordination with utility construction, backfilling, compaction and testing at least 48 hours in advance of the work for approval by the COTR. The plan shall be coordinated with the demolition and protection plans of this section.

SD-08, Statements

The Contractor shall provide a Protection Plan of the existing utilities, facilities and any other structures to remain undisturbed during construction to the COTR at least 48 hours in advance of the work.

SD-09, Reports

Test Reports shall be submitted in writing by the Contractor for Daily Inspection and Field and Laboratory Soil Test results within 3 working days. Reports shall be as specified in the paragraph entitled "Quality Control Testing During Construction" of this section.

SD-13, Certificates

Certificates of Compliance for Soil Materials shall be submitted in accordance with the paragraph entitled "Tests for Proposed Soil Materials" of this section.

SD-18, Records

Record of Existing Conditions shall be submitted by the Contractor prior to the start of this work. The COTR will provide any Underground Record information upon request. The Contractor shall verify that the conditions indicated on the Contract drawings are consistent with the available Underground Record information. Any discrepancies found shall be noted immediately, and notification given to the COTR so that instructions for proceeding can be given.

The records shall include the following:

Location and elevations of Underground Utilities
Location and elevations of Approved Utilities

Locations and elevations of all field soil tests

SD-18, Records

The Contractor shall be aware that the Record location of any underground utility or structure may be approximate. The actual locations of all utilities and structures encountered during excavation shall be noted in sketch form and the information conveyed to the COTR immediately. The locations of all soil tests and inspections shall also be noted and included with the results.

1.4 GENERAL REQUIREMENTS

The Contractor shall be held absolutely responsible for the safety of his workers as well as the protection of other Glenn employees and the Government property while engaging in earthwork operations - as well as all other aspects of the project. All applicable OSHA regulations must be adhered to and strictly enforced by the Contractor.

The requirements contained in ODOT 203 shall be adhered to; except as modified by these specifications.

1.5 LIMITS OF CONSTRUCTION

Work under this section includes excavation and backfill up to subgrade elevation and/or bottom of topsoil and in the area shown on the Contract drawings and approved by the COTR.

1.6 COMPACTION EQUIPMENT

The Contractor shall consult with a Geotechnical Engineer about the types of equipment to use to achieve the specified soil compaction. Compaction equipment shall be of suitable type and size, and shall consist of vibrating tampers, back hoe mounted hydraulic compactors, sheeps-foot rollers or other compaction equipment capable of obtaining the required density throughout the entire lift being compacted.

Generally, clay-type soils will require high energy tampers, rammers or sheeps-foot rollers. Sand, gravel or other granular soils require vibrating equipment with smooth plates or wheels.

The COTR, based on recommendations by the Geotechnical Engineer, or a demonstrated lack of performance on the job, reserves the right to reject the equipment types chosen by the Contractor. All costs associated with replacing the compaction equipment shall be paid by the Contractor.

1.7 LABORATORY AND FIELD SAMPLING AND TESTING

1.7.1 Environmental Soil Testing

The Government will supply an environmental site assessment report containing the information needed to characterize the excavated soil for disposal, as well as the level of personal protective equipment needed for workers in contact with that soil.

1.7.2 Geotechnical Construction Soil Testing

The Contractor shall retain a Geotechnical engineering and testing service, approved by the COTR, to provide sampling, laboratory tests on proposed backfill materials, field tests on in-place backfill soil for quality control, and to make daily verbal and written progress reports to the COTR. Testing agency shall conform to the requirements of ASTM D 3740.

1.7.3 Geotechnical Soil Tests for Proposed Backfill Materials

Soil materials proposed for backfill on this project shall be as specified on the Contract drawings. The materials shall be tested by the Contractor and approved by the COTR prior to the start of work. Each separate backfill type shall be tested as follows:

| <u>Requiremen</u> | <u>Test Method</u> |
|--|-------------------------------|
| Sampling | AASHTO T 2 |
| Preparation of Samples | AASHTO T 87 |
| Sieve Analysis of Aggregates | ASTM C 136 |
| Mechanical Analysis of Soils | ASTM D 422 |
| Liquid Limits, Plastic Limits and Plasticity Index | ASTM D 4318 |
| Moisture-Density Relationship (Standard Proctor Test) | AASHTO T 180 method B or D |

1.7.4 Quality Control During Construction

The field representative (inspector) from the soil testing agency shall be present during al backfilling and compaction operations.

Backfill materials shall be inspected and tested after placement and compaction during construction for in-place density, moisture content and compliance with design requirements as follows:

| <u>MATERIA</u> | <u>REQUIREMEN</u> | <u>TEST METHOD AND NO. TESTS</u> |
|---------------------------------------|--|--|
| All | Lift thickness; Material type; Compaction method | Measurement and visual inspection of every lift; Continuous |
| Granular: Bank run sand; Gravel | In-place density; Judgement of moisture content | Visual inspection of every lift using a hand probe or other method approved by the COTR |

| <u>MATERIA</u> | <u>REQUIREMEN</u> | <u>TEST METHOD AND NO. TESTS</u> |
|----------------|-------------------|--|
| Site soil; | In-place dry | ASTM D 1556 Sand Cone |
| Clay borrow; | density and | Method or ASTM D 2922 |
| Silt/clay mix | moisture content | Nuclear Method or as directed by the COTR to ensure that the specified compaction is achieved |

The intent of the inspection procedure is to aid the Contractor in accomplishing the specified work while that work is being done. The Contractor is encouraged to utilize the soil testing agency to the fullest in order to minimize disputes over the degree of compaction achieved.

The COTR, at his discretion, may request additional compaction tests.

1.7.5 Reports

Backfilling operations shall not proceed until written laboratory test results on the soil proposed for use are available, reviewed and approved by the COTR.

The field inspector retained by the Contractor shall verbally report to the COTR on a daily basis to review progress on the project. Results of all field tests will be reported.

The field inspector retained by the Contractor shall submit a written daily report within three working days following completion of the field tests, detailing the progress of the backfilling operation, visual inspection results and field test results. All deviations from this specification and the corrective action taken shall be described. A duplicate copy of all written material shall be retained by the Contractor.

1.7.6 Evaluation of Test Results and Subsequent Requirements

The Contractor will be informed of all test results immediately after they are concluded.

Granular soil materials delivered to the backfill location will be rejected if the moisture content, in the judgement of the construction inspector and the COTR, is so high that proper compaction can not be achieved.

A lift of clay-type soil will be considered satisfactory if the result of the in-place dry density test is no more than 1 percentage point below that specified for that material.

Results of in-place dry density tests will be considered satisfactory if the average of any group of four consecutive tests demonstrates a dry density equal to or greater than the specified value for that material and if no single test reveals a dry density value more than 2 percentage points below the specified value.

If the field inspector retained by the Contractor determines that the

reason the soil is failing to achieve specified compaction is that the moisture content is too high, then the soil must be removed and replaced; or disced, dried and recompact.

If the COTR determines that the reason soil tests or visual inspections of granular material are not meeting the specified compaction is due to inadequate compaction equipment or procedure, then the COTR will require the Contractor to replace such equipment and procedures until compaction can be consistently achieved at no additional charge to the Government.

If, in the judgement of the COTR, a significant material change has occurred between the material that was laboratory tested and that which is being placed, then the COTR will request that an additional laboratory dry-density test be run on the new material, at the Contractors expense, to establish what the maximum dry density and optimum moisture content are for the soil being placed.

PART 2 PRODUCTS

2.1 BACKFILL MATERIAL

Backfill material shall consist of low strength mortar backfill, bank run sand, washed pea gravel, crushed stone aggregate base or approved stockpiled or borrowed clay soil or silt/clay mixtures as per contract drawings.

Under no circumstances shall slag be used for any purpose on Government property. This requirement supercedes all other referenced specifications.

2.1.1 Satisfactory Materials

Satisfactory soil materials shall consist of AASHTO M 145 Soil Classification Groups A-1, A-2-4, A-2-5 and A-3; and as approved by the COTR. Aggregate base and crushed stone shall consist of limestone or dolomite only.

2.1.2 Unsatisfactory Materials

Unsatisfactory materials shall consist of AASHTO M 145 Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, highly organic soils, and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

Any soil determined to be a solid waste shall not be reused as fill unless specifically instructed to do so in writing by the COTR. Any soil determined to be a hazardous waste shall be properly handled and disposed of per all applicable federal, state and local regulations.

2.2 STRUCTURAL MATERIALS

Materials used for shoring and bracing, such as sheet piling, uprights, stringers, and crossbraces, shall be in good serviceable condition. Any

timber used shall be sound and free from large or loose knots.

Pressure-treated timber shall be used where wood sheeting or piling is specified or indicated to be cut and left in place. Timber and treatment shall conform to AWPA C1. Pressure treatment for piles shall conform to AWPA C3. Chromate Copper Arsenate (CCA) retention shall be not less than 0.8 pounds per cubic foot.

PART 3 EXECUTION

3.1 GENERAL

Before starting earthwork, the location of all utilities shall be verified to the fullest extent possible. Utilities to remain shall be protected from damage.

Excavation, backfilling and grading shall be to subgrade elevations calculated from the finished grades shown on the Contract drawings and the detailed cross-sections.

Excavated materials to be re-used for backfill shall be stockpiled in an orderly manner sufficiently distant from the excavation to prevent overloading the sides and causing a failure.

3.2 CLEARING AND GRUBBING

Prior to ditching operations, the Contractor shall strip and clear the area off all sod grasses and their associated root structures to a depth of 75 mm. This stripped organic material shall be handled as construction debris and hauled offsite at the Contractor's expense.

3.3 EXCAVATION

The Contractor shall cut all excavations so that the sides are vertical in order to minimize the generation of soil for disposal. Trench box and/or shoring is required.

The Contractor shall maintain at the project site the capability to rapidly de-water the excavations if required.

The Contractor shall assign a competent person(s) to be present at open excavations as appropriate for the situation; shall maintain means of egress, and provide emergency rescue equipment.

3.4 SHORING, BRACING AND SHEETING

Excavation, trenching and shoring requirements for the protection of employees found in OSHA Regulations, CFR 29 Part 1926, SUBPART P shall be enforced.

The Contractor shall retain the services of a professional engineer registered by the State of Ohio qualified to design the excavation shoring and protective systems required by the project. This design shall be submitted to the COTR for approval at least 2 weeks prior to commencing

excavation operation. The Contractor is encouraged to enlist the services of the Geotechnical Engineer to aid in the preparation of these plans.

Shoring and bracing shall be maintained regardless of the amount of time the excavations shall remain open. Shoring and bracing shall be carried down with the excavation.

Materials used for shoring and bracing shall be in good serviceable condition subject to the approval of the COTR. Timber shall be sound and free of large or loose knots.

Red oak or ash timber shall be used where wood sheeting or piling is specified or indicated to be cut and left in place.

At the discretion of the COTR, portions of the sheeting or shoring may be left in place and the Contract adjusted accordingly.

Trench boxes shall be used wherever possible in trench excavating.

3.5 TRENCH EXCAVATION

Trenches shall be executed according to the details shown on the Contract drawings or as approved by the COTR. Trench sides shall be as nearly vertical as possible. Bottoms of the trenches shall be accurately graded to provide uniform support to the bedding material and shall be free of all loose material and in a compact state. The bottom of all excavations shall not be considered finished until approval has been received from the construction inspector and/or the COTR. Over-excavation down below the detailed bottom elevation to remove soft or unstable material shall only be permitted at the expressed direction of the COTR with the trench bottom subsequently refilled to the designed bottom elevation with compacted granular material. Trenches are to be considered confined spaces. All appropriate precautions shall be taken until proven otherwise via testing or use of adequate controls.

3.6 REMOVAL OF EXCESS EXCAVATED SOIL AND DISPOSAL OF WASTE MATERIALS

Excess excavated materials have been designated as Commercial Fill Soils and shall be removed from Government property and transported to a Commercial Fill Site meeting the definitions found in the Ohio Voluntary Action Program OAC 3745-300.

No soil shall be removed from the site without the written authorization from the Government in the form of completed and signed Soil Manifests and Property Passes. The Contractor, working through the COTR, shall obtain the required NASA signatures on all Soil Manifests and Property Passes.

Waste materials, other than soil, such as trash and debris, shall be removed from NASA property and be legally disposed of as construction debris. The Contractor shall pay all permits and fees for disposal.

3.7 WATER REMOVAL

The Contractor shall take all necessary precautions to prevent storm water

runoff from entering any excavation. Water shall not be permitted to accumulate in excavations. Dewatering systems shall be provided by the Contractor to convey water away from excavations so that softening of foundation bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur. Dewatering systems and methods of disposal shall be approved by the Contracting Officer.

Dewatering shall be continued until backfill is completed.

Water removal from excavations shall be conveyed to approved collecting or runoff areas. Temporary drainage ditches and other diversions shall be provided by the Contractor and maintained outside of excavation limits.

Trench excavations for utilities shall not be used for temporary drainage ditches.

3.8 SANITARY AND STORM SEWERS

The requirements of ODOT 603 shall be adhered. Conduit type (pipe) and bedding Class shall be as specified and/or detailed on the Contract drawings.

3.9 APPURTENANCES

Excavations for manholes, vaults and other similar structures shall be kept to minimum dimensions practical to execute the work.

3.10 BACKFILLING

3.10.1 Bedding

Class B bedding under the new utility, except where noted on the contract drawings, shall consist of a minimum of 153 mm of No. 57 limestone, compacted, and approved by the COTR prior to placing that utility. Where noted on the contract drawings, bedding shall consist of ODOT 604 Class A bedding, ODOT 499 Class C concrete.

Bedding on the sides and top of the new utility shall be as detailed on the Contract drawings, consolidated as much as possible without damaging the utility.

3.10.2 Between Bedding and Subgrade

Under pavements, ground slabs and structures the remainder of the fill shall be low strength mortar backfill; see Section 02238, "Low Strength Mortar Backfill or compacted bank run sand a minimum of 2 m beyond the edge of pavement. Pavement includes all asphalt and concrete roads, drives, walks, and parking areas.

Lift thickness shall be no more than 203 mm throughout. Lift thickness not applicable to low strength mortar backfill.

Compaction requirements are as follows:

| <u>Materia</u> | <u>Requirement</u> |
|---|-------------------------|
| Fill under pavements, walks, etc. | 95% Maximum Dry Density |
| Fill under grassed areas | 90% Maximum Dry Density |
| Every lift shall be inspected, tested and approved prior to the placement of the subsequent lift. Lift thickness not applicable to low strength mortar. | |

3.11 DISPOSAL OF EXCESS AND WASTE MATERIALS

Soil shall be disposed of in accordance with Section 01104.

All demolished items such as utilities, pavements, structures, etc. shall be removed from Government property and disposed of as construction debris.

3.12 RESTORATION OF SURFACES

Areas within the limits of earthwork under this section, including adjacent transition areas, shall be uniformly graded. The finished surface shall be smooth within the specified tolerances, compacted, and with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

Grassed areas:

The finished surface of areas to receive topsoil shall be not more than 30.5 mm above or below the specified finish elevations.

Walks:

The surface of areas under walks shall be shaped to line, grade, and cross section, and the finished surface shall be not more than 15.3 mm above or 15.3 mm below the specified finish elevations.

Pavements:

The surface of areas under pavements shall be shaped to line, grade, and cross section, and the finished surface shall be not more than 12.2 mm above or below the specified finish elevations.

-- End of Section --

SECTION 02238

LOW STRENGTH MORTAR BACKFILL

01/92

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 150 (1995) Standard Specifications for
Portland Cement

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT 499 (1997) Concrete General; and Subparts as
Specified

ODOT 701 (1997) Hydraulic Cement; and Subparts as
Specified

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330,
"Submittals," in sufficient detail to show full compliance with the
specification:

SD-13, Certificates

Certificates of Compliance shall be submitted demonstrating
compliance with the mix design specified herein. Certificates
must contain project name and Contract number, date, name of
Contractor, name of supplier and the mix design data.

PART 2 PRODUCTS

2.1 GENERAL

All materials shall conform to the applicable requirements of ODOT 499.

2.2 MATERIALS

2.2.1 Cement

Cement shall conform to ODOT 701.01 or ODOT 701.04, (ASTM C 150 Type I or
Type II).

2.2.2 Fine Aggregate

Fine aggregate shall be natural sand consisting of mineral aggregate
particles.

The gradation of the sand shall be:

| <u>Sieve Siz</u> | <u>Percent Passing</u> |
|------------------|------------------------|
| No. 4 | 90-100 |
| No. 50 | 7-40 |
| No. 200 | 0-10 |

It is intended that the sand be fine enough to stay in suspension in the mixture during all placement activities, without segregation. The COTR reserves the right to reject the sand gradation if a flowable mixture is not produced at the project site.

2.2.3 Performance Enhancing Admixture

A performance enhancing admixture shall be incorporated in the mix that shall have the effect of lowering the wet density to a maximum of 1600 kg per cubic meter, a 28-day cured compressive strength of 3.5 to 7.0 kilograms per square centimeter; entrained air content 30% minimum and shall eliminate bleed water and segregation. This admixture product shall be specifically manufactured for this purpose and shall be used at the recommended design rate. An approved accelerating agent shall be added to the first lift; and may be added to the following lifts if a faster setting time is desired.

2.3 MORTAR DESIGN MIX

The initial trial mix shall be proportioned as follows:

Quantities of Dry Materials Per Cubic Meter

| | |
|------------------------|----------|
| Cement | 60 kg |
| Sand (SSD)* | 1,335 kg |
| Water | 163 kg |
| *saturated surface dry | |

These quantities of materials are expected to produce 1 cubic yard of mortar of the proper consistency. Upon approval by the COTR, the Contractor may make adjustments to the mix design if it is determined that a properly flowable material is not being produced. Twenty-eight day cured compressive strength shall be in the range of 3.5 to 7.0 kilograms per square centimeter. Four test cylinders of the trial mix shall be taken and tested by a testing lab all at the Contractor's expense. Adjustments will be made such that the total volume remains constant.

2.4 ON-SITE MIXING EQUIPMENT

Mortar shall be mixed on site by mixers of sufficient capacity to permit the mortar to be placed in a minimum quantity of 4.59 cubic meters at a

time, or as approved by the COTR.

2.5 READY-MIX MORTAR

Low strength mortar backfill shall be supplied by a ready-mix supplier approved by the COTR and delivered to the project site in standard concrete delivery trucks.

PART 3 EXECUTION

3.1 PLACING MORTAR

Mortar shall be discharged from the mixer or truck as close to the fill location as possible in a manner that will minimize spillage. The mortar shall be brought up uniformly to the fill line shown on the Contract drawings or as directed by the COTR.

3.2 TEST CYLINDERS

Test cylinders shall be taken at the rate of four (4) cylinders per day for compressive strength tests by a lab at 7, 14, and 28 days. Test may be discontinued at the discretion of the COTR if tests consistently fall within the specified range of strength.

-- End of Section --

SECTION 02311

EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURES
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

| | |
|--------------|---|
| AASHTO M 145 | (1991) Recommended Practice for the Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes |
| AASHTO T 103 | (1991) Soundness of Aggregates by Freezing and Thawing |
| AASHTO T 180 | (1993) Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-In. (457 mm) Drop |
| AASHTO T 2 | (1991) Standard Methods of Sampling of Aggregates |
| AASHTO T 87 | (1986; Rev 1993) Standard Method for the Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|------------|--|
| ASTM C 117 | (1995) Standard Test Method for Materials Finer than 75-microns (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C 131 | (1989) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C 136 | (1995; Rev A) Standard Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C 32 | (1993) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale) |
| ASTM C 33 | (1993) Standard Specification for Concrete Aggregates |

| | |
|-------------|---|
| ASTM C 387 | (1987) Standard Specification for Packaged, Dry Combined Materials for Mortar and Concrete |
| ASTM C 700 | (1991) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated |
| ASTM C 88 | (1990) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| ASTM D 1556 | (1990) Standard Test Method for Density of Soil in Place by the Sand-Cone Method |
| ASTM D 1557 | (1991) Test Method for Laboratory Compaction of Soil Using Modified Effort (56,000 ft-lbf/ft (2700 kN-m/m)) |
| ASTM D 2216 | (1992) Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures |
| ASTM D 226 | (1994) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing |
| ASTM D 227 | (1994) Standard Specification for Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing |
| ASTM D 2922 | (1991) Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| ASTM D 3282 | (1993) Standard Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes |
| ASTM D 3740 | (1994) Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction |
| ASTM D 422 | (1963; R 1990) Standard Test Method for Particle-Size Analysis of Soils |
| ASTM D 4318 | (1995) Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926

(1996) Safety and Health Regulations for
Construction

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-07 Schedules

Construction Equipment List of all major equipment to be used shall be submitted.

SD-09 Reports

Test Reports shall be submitted for soil test results within 3 working days. Test reports shall be submitted according to paragraph entitled, "Quality Control Testing During Construction," of this section.

SD-13 Certificates

Certificates of Compliance for Proposed Soil Materials shall be submitted according to paragraph entitled, "Tests for Proposed Soil Materials," of this section.

Certificates of Compliance for Compost shall be submitted indicating grade and compliance with state and local regulations.

SD-18 Records

A Record of Existing Conditions shall be recorded, in the presence of the Contracting Officer, and shall include all structures and other facilities adjacent to areas of work. Such records shall contain the location of existing utilities, the elevation of the top of foundation walls, the location and extent of cracks and other damage, and a description of surface conditions that exist prior to the start of work. Copies of the record shall be submitted and the conditions prior to starting work shall be verified.

1.3 LIMITS OF CONSTRUCTION

Work in this section relates to excavation, fill, and backfill to a point 1500 millimeter beyond the building or structure line.

1.4 SAMPLING AND TESTING

1.4.1 Soil Testing and Inspection Service

Soil survey for satisfactory soil materials and samples of soil materials shall be furnished by the Contractor. A certified soil-testing service approved by the Contracting Officer shall be provided by the Contractor.

Testing shall include soil survey for satisfactory soil materials; sampling and testing soil materials proposed for use in the work, and field-testing facilities for quality control during construction period.

Testing agencies shall conform to the requirements of ASTM D 3740.

1.4.2 Tests For Proposed Soil Materials

Materials shall be approved by the Contracting Officer prior to start of work.

Soil materials proposed for use in the work shall be tested as follows.

| <u>MATERIA</u> | <u>REQUIREMEN</u> | <u>TEST METHO</u> | <u>NUMBER OF TESTS</u> |
|--|--|--------------------------|--|
| Satis- factory soil materials | Sampling | AASHTO T 2 | One from each source of materials to determine con- formance to definition of satisfactory soil materials; additional tests whenever there is any apparent change |
| | Preparation of samples | AASHTO T 87 | |
| | Sieve analysis is of fine and coarse aggre- gates | ASTM C 136 | |
| | Amount of material pass- ing 75 micrometer sieve | ASTM C 117 | |
| | Liquid limit | ASTM D 4318 | |
| | Plastic limit and plasticity index | ASTM D 4318 | |
| | Mechanical analysis | ASTM D 422 | |
| | Moisture- density relations | ASTM D 1557, Method D | As required to determine moist- ure-density re- quirement of materials from each source |
| | Los Angeles abrasion of coarse aggre- gates | ASTM C 131 | One for each soil material from each source if called for in |

| <u>MATERIA</u> | <u>REQUIREMEN</u> | <u>TEST METHO</u> | <u>NUMBER OF TESTS</u> |
|----------------|-------------------|-------------------|----------------------------|
| | | | reference specification |

Freezing and
thawing sound-
ness of aggre-
gates

AASHTO T 103

Magnesium Sul-
fate Soundness
Test

ASTM C 88

1.4.3 Quality Control Testing During Construction

Soil materials shall be tested during construction as follows:

| <u>MATERIA</u> | <u>REQUIREMEN</u> | <u>TEST METHO</u> | <u>NUMBER OF TESTS</u> |
|---|---|--|---|
| Soil materials specified | Sieve analysis of fine and coarse aggre- gates | ASTM C 136 | One daily for each soil material from each source; additional test whenever there is any apparent change |
| | Amount of material pass- ing 75 micrometer sieve | ASTM C 117 | |
| | Moisture con- tent of subbase material | ASTM D 2216 | |
| Soil materials prior to compaction | Moisture-den- sity relations of soil | ASTM D 1557, Method D | One of each type of sub- grade soil material except under backfill for structures; one for each backfill and fill material from each source |
| Soil material- in-place after com- | Density of soil-in-place | ASTM D 1556, Sand Cone Method or ASTM D 2922, | At least three daily for each subgrade soil material except |

| <u>MATERIAL</u> | <u>REQUIREMEN</u> | <u>TEST METHO</u> | <u>NUMBER OF TESTS</u> |
|-----------------|-------------------|--|---|
| paction | | Nuclear Method (when approved by Contracting Officer) | under backfill for structures, and for each layer and back- fill and fill material; ad- ditional test whenever there is any change in moisture conditions |

1.4.4 Test Reports

No soil material shall be used until test reports have been reviewed and approved.

1.4.5 Evaluation of Test Results

Results of density of soil-in-place tests shall be considered satisfactory if the average of any group of four consecutive density tests which may be selected is in each instance equal to or greater than the specified density, and if not more than one density test in five has a value more than 2 percentage points below the specified density.

PART 2 PRODUCTS

2.1 BACKFILL AND FILL MATERIALS

Materials for backfill and fill shall be free of clay clods, rock or gravel larger than 50 millimeter in any dimension, debris, waste, frozen materials, and other deleterious matter and shall be satisfactory soil materials as follows:

| <u>AREA CLASSIFICATIO</u> | <u>BACKFILL OR FILL MATERIALS</u> |
|---|--|
| In excavations, unless otherwise specified | Excavated or borrow material that has been sampled, tested, and approved as "Satisfactory Soil Material" |
| Against face of structures where footing drains from top of porous fill for footing drains to indicated elevation, and from face of structure a distance equal to three footing drain diameters | Filtering material |
| Against surfaces having applied waterproofing for a distance of at least | Sand |

AREA CLASSIFICATIONBACKFILL OR FILL MATERIALS

150 millimeter
from surface

In foundation subdrain
trenches over porous fill
drain pipe

Under grassed areas

Under walks, steps,
and paved areas

Under building slabs

Filtering material

Excavated or borrow material
that has been sampled,
tested, and approved as
"Satisfactory Soil
Material"

Subbase material or exca-
vated or borrow material
that has been sampled,
tested, and approved as
"Satisfactory Soil
Material"

Drainage fill

2.1.1 Satisfactory Materials

Satisfactory materials shall mean AASHTO M 145, (ASTM D 3282) Soil Classification Groups A-1, A-2-4, A-2-5, and A-3.

2.1.2 Unsatisfactory Materials

Unsatisfactory soil materials shall mean AASHTO M 145, Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, peat and other highly organic soil, and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

2.2 TOPSOIL

Topsoil shall be any soil removed from the project site which consists of clay or sandy loam.

The topsoil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and shall be free from stones, stumps, roots, and other objectionable materials larger than 50 millimeter in any dimension.

2.3 COMPOST

Compost shall be yard trimmings or yard waste compost processed and graded according to state and local regulations.

2.4 TOPSOIL BLEND

Where insufficient topsoil is removed from the project site the topsoil removed shall be stockpiled and blended with compost at the site to achieve the required volume.

2.5 COHESIONLESS MATERIALS

Cohesionless soil materials include gravels, gravel-sand mixtures, sands, and gravelly-sands. Moisture-density relations of compacted cohesionless soils, when plotted on graphs, will show straight lines or reverse-shaped moisture density curves.

2.6 COHESIVE MATERIALS

Cohesive soil materials include clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands. Moisture-density relations of compacted cohesive soils, when plotted on graphs, will show normal moisture-density curves.

2.7 SUBBASE MATERIAL

Subbase material shall be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone, or sand.

2.8 DRAINAGE FILL

Drainage fill shall be a washed, uniformly graded mixture of crushed stone or crushed or uncrushed gravel, with 100 percent passing 37.5 millimeter sieve and not more than 5 percent passing 4.75 millimeter sieve.

2.9 FILTERING MATERIAL

Filtering material shall conform to ASTM C 33 and shall be a uniformly graded mixture of natural or crushed gravel, crushed stone, and natural sand, with 100 percent passing 9.5 millimeter sieve and 2 to 10 percent passing a 150 micrometer sieve.

2.10 SAND

Sand shall be natural sand.

2.11 DRAINAGE PIPE AND FITTINGS

Drainage pipe shall be extra-strength perforated clay pipe, ceramic glazed, of size indicated, with self-centering lugs in bell ends, and shall conform to ASTM C 700.

Fittings shall be of corresponding weight and quality as drainage pipe.

2.12 SEWER BRICK AND MORTAR MATERIALS

Sewer brick shall be standard brick size and shall conform to ASTM C 32, Grade MM.

Mortar materials shall be dry packaged, proportioned for Type M unit masonry mortar, and shall conform to ASTM C 387.

Mixing water for mortar shall be potable.

PART 3 EXECUTION

3.1 PREPARATION

Before earthwork is started, the location of underground utilities shall be carefully verified by hand methods. Utilities to be left in place shall be protected from damage.

3.2 UNAUTHORIZED EXCAVATION

Unauthorized excavation shall consist of removal of materials beyond indicated subgrade elevations or side dimensions specified without specific direction and shall be replaced as specified at no additional cost to the Government.

Unauthorized excavation under foundations or retaining walls shall be filled by lowering the bottom elevation of the footing or base to the excavation bottom without altering the approved top elevation.

Elsewhere unauthorized excavations shall be backfilled and compacted as specified for authorized excavations of the same classification.

3.3 CLEARING AND GRUBBING

Prior to ditching operations, the Contractor shall strip and clear the area off all sod grasses and their associated root structures to a depth of 75 mm. This stripped organic material shall be handled as construction debris and hauled offsite at the Contractor's expense.

3.4 SHORING, BRACING AND SHEETING

Excavation, trenching and shoring requirements for the protection of employees found in OSHA Regulations CFR 29 Part 1926, SUBPART P shall be enforced.

The Contractor shall retain the services of a professional engineer registered by the State of Ohio qualified to design the excavation shoring and protective systems required by the project. This design shall be submitted to the COTR for approval at least 2 weeks prior to commencing excavation operation. The Contractor is encouraged to enlist the services of the Geotechnical Engineer to aid in the preparation of these plans.

Shoring and bracing shall be maintained regardless of the amount of time the excavations shall remain open. Shoring and bracing shall be carried down with the excavation.

Materials used for shoring and bracing shall be in good serviceable condition subject to the approval of the COTR. Timber shall be sound and

free of large or loose knots.

Red oak or ash timber shall be used where wood sheeting or piling is specified or indicated to be cut and left in place.

At the discretion of the COTR, portions of the sheeting or shoring may be left in place and the Contract adjusted accordingly.

Trench boxes shall be used wherever possible in trench excavating.

3.5 WATER REMOVAL

The Contractor shall take all necessary precautions to prevent storm water runoff from entering any excavation. Water shall not be permitted to accumulate in excavations, or flood the site and surrounding area. Dewatering systems shall be provided by the Contractor to convey water away from excavations so that softening of foundation bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur. Dewatering systems and methods of disposal shall be approved by the Contracting Officer.

Dewatering shall be continued until construction subject to water pressure has obtained full specified strength and backfill is completed.

Water removal from excavations shall be conveyed to approved collecting or runoff areas. Temporary drainage ditches and other diversions as necessary shall be provided and maintained outside of excavation limits.

Trench excavations for utilities shall not be used for temporary drainage ditches.

3.6 MATERIAL STORAGE

Excavated materials classified as satisfactory soil material shall be stockpiled, where directed, until required for backfill or fill. Stockpiles shall be placed, graded, and shaped for proper drainage.

Materials required in the work shall be located and retained a sufficient distance from the edge of excavations to prevent such material falling or sliding back into the excavations and to prevent cave-ins.

3.7 EXCAVATION FOR STRUCTURES

Excavation for structures shall conform to the dimensions and elevations indicated within a tolerance of plus or minus 30 millimeter and shall extend a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services and other construction indicated, and for inspection.

In excavating for footings and foundations, care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall be done just before concrete is placed. Bottoms shall be trimmed to the required lines and grades to leave a solid bed to receive concrete.

For pile foundations, excavation shall stop at an elevation of from 150 to 300 millimeter above the bottom of the footing before piles are driven. After pile driving has been completed, loose and displaced material shall be removed and excavation to final grade shall be done, leaving a solid bed to receive concrete.

3.8 EXCAVATION FOR FOUNDATION SUBDRAINAGE SYSTEM

Contractor shall adhere to and enforce precautions as outlined in OSHA Regulations, 29 CFR 1926.

Excavation for foundation subdrainage system, except for footing drains located in the excavations for footings and foundations, shall have vertical sides for a vertical dimension above the bottom of the trench not less than two times the outside dimension of the drain pipe, and shall have a clear horizontal distance between the drain pipe barrel and the trench wall, on both sides, of not less than 150 millimeter nor more than 225 millimeter. Bottom of the trench excavations shall be graded to obtain the required slope and shall be tamped to provide a firm bed for the drain pipe bedding material.

3.9 REMOVAL OF EXCESS EXCAVATED SOIL AND DISPOSAL OF WASTE MATERIAL

Excess excavated materials have been designated as Commercial Fill Soils and shall be removed from Government property and transported to a Commercial Fill Site meeting the definitions found in the Ohio Voluntary Action Program OAC 3745-300.

No soil shall be removed from the site without the written authorization from the Government in the form of completed and signed Soil Manifests and Property Passes. The Contractor, working through the COTR, shall obtain the required NASA signatures on all Soil Manifests and Property Passes.

Waste materials, other than soil, such as trash and debris, shall be removed from NASA property and be legally disposed of as construction debris. The Contractor shall pay all permits and fees for disposal.

3.10 REMOVAL OF UNSATISFACTORY SOIL MATERIALS

Unsatisfactory soil materials encountered that extend below the required elevations shall be excavated to the depth directed by the COTR.

3.11 REMOVAL OF EXISTING UNDERGROUND UTILITIES

Existing underground utilities indicated to be removed shall be demolished and completely removed from the excavation.

3.12 CLOSING ENDS OF ABANDONED UNDERGROUND UTILITIES

Open ends of abandoned underground utilities to remain shall be closed with hydraulic cement to prevent water that may accumulate in such utilities from flowing into excavated areas. Closures shall withstand any hydrostatic or earth pressure that may result after ends of the abandoned utilities have been closed.

Open ends of abandoned underground utilities to remain shall have brick masonry bulkheads constructed to completely close the openings and sealed with 26 mm of hydraulic cement.

Mortar shall be mixed with water for workability by methods that can be controlled and accurately maintained during work progress. Retempering of mortar will not be permitted. Mortar mixing and conveying equipment shall be kept clean. Mortar shall not be deposited or permitted to contact the ground.

Brick shall be wet when laid. Brick shall be laid in mortar so as to form full bed with ends and side joints in one operation and with joints not more than 10 millimeter wide. Fresh masonry work shall be protected from freezing and from too rapid drying from effects of sun and wind. Protection shall be maintained until mortar has set.

Open ends of metallic conduit and pipe shall be closed with threaded galvanized metal caps or plastic plugs or other approved method suitable for the type of material and size of pipe. Wood plugs will not be permitted.

3.13 FOUNDATION SUBDRAINAGE SYSTEM

Foundation subdrainage system outlets shall drain by gravity to free outfall to point of discharge.

3.13.1 Impervious Fill At Footings

After concrete footings have been cured as specified, impervious fill at least 150 millimeter in depth and 300 millimeter in width shall be placed on the subgrade adjacent to the bottom of footing and shall be compacted at optimum moisture content by means of hand tampers to not less than the density specified for cohesive material. Impervious fill shall be clayey soil material conforming to AASHTO M 145, Soil Classification Groups A-2-6 and A-2-7.

3.13.2 Laying Drain Pipe

Drain pipe shall be laid with the perforations down and firmly bedded in specified drainage fill material, with each pipe section having full bearing throughout its length to true grades and alignment and continuous fall in the direction of flow. One-eighth bends shall be used for changes in direction; Y-fittings shall be used at intersections. Drain pipe joints shall be closed.

Recesses in the excavation bottom shall be excavated to receive bells for drain pipe having bell and spigot ends. Such pipe shall be laid with bells facing up the slope and with spigot end entered fully into the adjacent bell.

3.13.3 Testing Drain Lines

Drain lines shall be tested with water before backfilling to ensure free

flow. Any obstruction encountered shall be removed, damaged components replaced, and system retested until satisfactory.

3.13.4 Porous Fill Over Drain Pipe

After drain lines have been tested, drain pipe shall be backfilled to a width of at least 100 millimeter on sides and 300 millimeter above the top of pipe with specified drainage fill material. Fill material shall be placed in layers not exceeding 75 millimeter in loose depth and compacted with not less than two passes of a hand-operated plate type vibrating compactor. Fill material shall be overlaid with one layer of 0.7 newton per 10 square meter asphalt or tar-saturated felt conforming to ASTM D 226 or ASTM D 227, respectively.

3.14 FILLING AND BACKFILLING

3.14.1 Preparations Prior to Backfill Placement

Excavations shall be backfilled as promptly as the work permits but not until completion of the following:

- Approval of construction below finish grade

- Inspection, testing, approval, and recording location of underground utilities

- Removal of concrete formwork

- Removal of shoring and bracing; backfilling of voids with satisfactory soil material; temporary sheet piling driven below bottom of structures; and cutting off and removing of utilities in a manner that prevents settlement of the structure or utilities

- Removal of trash and debris

- Completion of concrete waterproofing

3.14.2 Preparation of Ground Surface to Receive Fill

Vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials shall be removed from ground surface prior to the placement of fills. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stripped, or broken up in such manner that fill material will bond with the existing material.

When the ground surface has a density less than that specified for the particular area classification, the ground surface shall be broken up, pulverized, moisture-conditioned to near optimum moisture content of the soil material, and compacted to the required depth and percentage of maximum density.

3.14.3 Placement and Compaction

Backfill and fill materials shall be placed in layers not more than 150

millimeter in loose depth. Before compaction, each layer of backfill or fill material shall be moistened or aerated as necessary to provide the optimum moisture content of the soil material and shall then be compacted to the percentage of maximum density for each area classification as specified. Backfill or fill material shall not be placed on surfaces that are muddy, frozen, icy, or contain frost.

Backfill and fill materials adjacent to structures shall be brought up evenly around structures and shall be carried up to the indicated elevations.

Compaction adjacent to structures, within a horizontal distance from the face of the structure equal to the depth of backfill or fill material (measured from the bottom of footing or bottom of foundation or retaining wall) to final grade, shall be done with power-driven hand tampers.

3.15 COMPACTION

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure in AASHTO T 180, Methods B or D.

3.15.1 Percentage of Maximum Density Requirements

Actual density of each layer of soil material-in-place shall be not less than the following percentages of the maximum density of the same soil material determined by the moisture-density test specified.

| <u>AREA CLASSIFICATION</u> | <u>PERCENT MAXIMUM</u> <u>COHESIONLESS</u> | <u>DENSITY</u> <u>COHESIVE</u> |
|--|---|-----------------------------------|
| | <u>SOIL MATERIAL</u> | <u>SOIL MATERIAL</u> |
| Structures | | |
| Each layer of back- fill material | 90 | 90 |
| Building slabs and steps | | |
| Top 300 millimeter of subgrade and each layer of backfill material | 95 | 95 |

3.15.2 Moisture Control

Moisture content in soil material at time of compaction shall be within limits specified.

Where the moisture content of a layer of soil material is below optimum before compaction, the required amount of water shall be uniformly applied to the surface of the layer of soil material and the layer of soil disked or otherwise mixed until a uniform moisture content is reached.

Moisture of a layer of soil material that is above optimum shall be removed

by drying.

3.16 GRADING

Areas within the limits of grading under this section, including adjacent transition areas, shall be uniformly graded. Finished surface shall be smooth within the specified tolerances, compacted, and with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

3.16.1 Grading Outside Building Lines

Areas outside the building lines for each structure shall be hand-graded to drain away from the structure and to prevent ponding of water after rains. Finished surface shall be within the tolerance specified below for each area classification, compacted as specified, and free from irregular surface changes.

Grassed or planted areas:

Finished surface of areas to receive topsoil blend shall be not more than 30 millimeter above or below the indicated finish elevations.

Walks:

Surface of areas under walks shall be shaped to line, grade, and cross section; finished surface shall be not more than 0.0 millimeter above or 30 millimeter below the indicated finish elevation.

Pavements:

Surface of areas under pavements shall be shaped to line, grade, and cross section; the finished surface shall be not more than 25 millimeter above or below the indicated finish elevation when tested with a 3000 millimeter straightedge applied both parallel with and at right angles to the centerline of the area. Finished surface shall vary no more than 25 millimeter.

3.16.2 Grading Surface of Fill Under Structures

Surface of fill under building slabs shall be smooth and even, free of voids, compacted as specified and to indicated grade within the specified tolerances. When tested with a 3000 millimeter straightedge, parallel with and at right angles to the building lines, the finished surface shall show no deviation in excess of 25 millimeter.

3.17 MAINTENANCE

3.17.1 Protection of Graded Areas

Newly graded areas shall be protected from traffic and erosion and shall be maintained free of trash and debris.

3.17.2 Reconditioning Compacted Areas

Where approved compacted areas are disturbed by subsequent construction operations or adverse weather, the surface shall be scarified, reshaped, and compacted as specified to the required density prior to further construction.

3.18 DISPOSAL OF EXCESS AND WASTE MATERIALS

Excess excavated satisfactory materials shall be transported to and disposed in designated storage areas on Government property.

Waste materials, including excavated material classified as unsatisfactory soil material, trash, and debris, shall be removed from Government property and legally disposed at no additional cost to the Government. Permits and fees for disposal shall be paid by the Contractor.

-- End of Section --

SECTION 02511

CONCRETE FOR SITE WORK

06/92

PART 1 GENERAL

1.1 SUMMARY

The work under this specification consists of all labor, services, materials, equipment and tools necessary to install and test cast-in-place concrete for slab(s) on grade, equipment pad(s), equipment foundation pier(s), as shown and detailed on the Contract Drawing(s). The work includes portland cement concrete, formwork, admixtures, expansion joints, testing, finishing and curing.

1.2 REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION
OFFICIALS (AASHTO)

AASHTO T 260 1984, Sampling and Testing for Total
Chloride Ion in Concrete and Concrete Raw
Materials

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 223 (1983) Standard Practice for the Use of
Shrinkage-Compensating Concrete

ACI 305R (1989) Hot Weather Concreting

ACI 306R (1988) Cold Weather Concreting

ACI 316R (1982) Construction of Concrete Pavements
and Concrete Bases, Recommendations for

ACI 318 (1989; 318R-89) Building Code Requirements
for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185 (1988) Welded Steel Wire Fabric for
Concrete Reinforcement

ASTM C 143 (1990) Slump of Portland Cement Concrete

ASTM C 172 (1990) Sampling Freshly Mixed Concrete

ASTM C 231 (1989a) Air Content of Freshly Mixed
Concrete by the Pressure Method

ASTM C 260 (1986) Air-Entraining Admixtures for
Concrete

| | |
|-------------|--|
| ASTM C 309 | (1989) Liquid Membrane-Forming Compounds for Curing Concrete |
| ASTM C 31 | (1990) Making and Curing Concrete Test Specimens in the Field |
| ASTM C 39 | (1986) Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C 494 | (1986) Chemical Admixtures for Concrete |
| ASTM C 94 | (1990) Ready-Mixed Concrete |
| ASTM D 1621 | 1979 Test Method for Compressive Properties of Rigid Cellular Plastics |
| ASTM D 3575 | 1984 Test Method for Flexible Cellular Materials made from Olefin Polymers |

CORPS OF ENGINEERS (COE)

| | |
|---------|--|
| COE 204 | (1977; Notice 24) Concrete (For Building Construction) |
|---------|--|

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

| | |
|----------|---|
| ODOT 499 | (1997) Concrete General; and Subparts as Specified |
| ODOT 509 | (1997) Reinforcing Steel; and Subparts as Specified |
| ODOT 511 | (1997) Concrete for Structures; and Subparts as Specified |
| ODOT 701 | (1997) Hydraulic Cement; and Subparts as Specified |
| ODOT 705 | (1997) Concrete Pavement Incidentals; and Subparts as Specified |
| ODOT 709 | (1997) Reinforcing Steel; and Subparts as Specified |

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01, Data

Mix Designs (Contractor and Job) shall be submitted for approval for each concrete class. The design for concrete properties shall equal or exceed the specified design properties.

SD-04 Drawings

Fabrication Drawings for the following items shall be submitted showing size and spacing:

Reinforcing Steel
Bar Lists

SD-04 Drawings

Erection/Installation Drawings shall be submitted including the size and spacing for the following items:

Reinforcing Steel
Bar Lists
Expansion and Construction Joint Details

SD-06, Instructions

Manufacturer's Instructions for all products used shall be submitted, including any special instructions for equipment installation, for approval prior to use.

SD-09 Reports

Test Reports for the following items shall be submitted in accordance with the paragraph entitled, "Concrete Testing During Construction:"

Slump
Air Content
Cylinder Test Specimens

SD-13, Certificates

Certificates of Compliance shall be submitted for the following items demonstrating conformance with the referenced specifications contained in this section. Certificates must contain project name and Contract number, date, name of Contractor, name of concrete testing service, source and mineralogy of aggregates, complete catalog information for all manufactured products proposed and test results.

Reinforcing steel
Form materials
Curing and sealing materials
Joint materials
Concrete materials
Concrete mix design

SD-14, Samples

Samples of each concrete mix shall be submitted in accordance with the paragraph entitled "Quality Control During Construction" of this section.

SD-18 Records

Daily Reports with the following items shall be submitted:

Delivery Tickets Copy

1.4 LABORATORY AND FIELD SAMPLING AND TESTING SERVICE

Sampling and testing services shall be provided by the Contractor at the direction of the Contracting Officers Technical Representative (COTR). The testing service agency shall be approved prior to commencing construction. The field testing shall be done to determine conformance with reference specifications and for quality control.

1.4.1 Laboratory Testing

Laboratory testing shall consist of running compressive strength tests on concrete cylinders prepared in the field according to ASTM C 39.

1.4.2 Field Testing and Quality Control During Construction

Concrete shall be sampled and tested at the direction of the COTR and as follows:

| <u>REQUIREMEN</u> | <u>TEST METHO</u> | <u>NUMBER OF TESTS</u> |
|----------------------|-------------------|---|
| Sampling | ASTM C 172 | As required for each test. |
| Slump | ASTM C 143 | One for each concrete load; one each time water or an admixture is added to the mix. |
| Air Content | ASTM C 231 | One at the point of delivery for each load and one for each set of compressive strength tests. |
| Compression test | ASTM C 31 | One set of four (4) standard specimens cylinders for each compressive strength test for each load, 76.5 cubic meters. |
| Concrete temperature | | Hourly when air temperature is 4.44 degrees Celsius and below or 26.67 degrees Celsius and above and each time a set of compressive test specimens is made. |

PART 2 PRODUCTS

2.1 READY-MIX CONCRETE

Concrete shall be ready-mix and shall conform to ASTM C 94.

The provisions contained in ODOT 499 apply to this specification as modified herein:

Minimum 28 day compressive strength of 281.2 kilograms per square centimeter.

Maximum chloride ion content of 0.30% by weight of cement in mix per cubic yard according to AASHTO T 260.

Air entrainment of 5% to 7% at point of placement.

Maximum delivered slump shall be 51 mm.

Maximum water-cement ratio shall be 0.40.

Course aggregate shall be limestone or dolomite only.

Mix water shall be potable.

2.1.1 Admixtures

The COTR shall approve all proposed admixture products prior to their use. The COTR, at his discretion, may direct the Contractor as to which admixtures to use. The application of all admixtures shall be done in strict accordance with the manufacturers instructions.

The Contractor is encouraged to use some or all of the following admixtures to ease constructability while complying with this specification and to produce a more durable product:

Slump may be increased to a maximum of 203 mm by adding an approved superplasticizer at the job site to ease casting.

Slump may be increased to a maximum of 254 mm by adding an approved batch plant added high-range water reducer producing a rheoplastic concrete to ease casting.

Note: water shall not be added at the job site for the purpose of increasing slump and easing casting.

Accelerator shall be non-corrosive and shall not contribute more than 0.005% chloride ion content by weight of cement and will comply with ASTM C 494, Type C.

A corrosion inhibiting admixture shall be included where concrete will be exposed to deicing salts or any other corrosive environment at the maximum rate allowed by the manufacturer.

Set-retarding admixture shall comply with ASTM C 494, Type D.

Water-reducing admixture shall comply with ASTM C 494, Type A.

Air-entraining admixture shall comply with ASTM C 260.

2.1.2 Shrinkage Compensating Concrete

The above specifications apply to this section and shall include the following:

Shrinkage compensating concrete shall be Type constructed according to ACI 223 and ODOT 701.08.

Minimum cement content per cubic meter is 305.5 kilograms.

Maximum water-cement ratio can be increased to 0.50.

Maximum delivered slump can be increased to 101.6 mm.

2.2 REINFORCING MATERIALS

2.2.1 Reinforcing Steel

Reinforcing bars shall meet the requirements of ODOT 509.

2.2.1.1 Epoxy-Coated Reinforcing Steel

Epoxy-coated reinforcing bars shall meet the material requirements of ODOT 709.00.

2.2.1.2 Deformed and Plain Billet Steel Bars for Concrete Reinforcement

Reinforcing bars shall meet the material requirements of ODOT 709.01.

2.2.1.3 Welded Steel Wire Fabric for Concrete Reinforcement

Welded steel wire fabric shall meet the material requirements of ODOT 709.10, ODOT 709.11, ODOT 709.12, or ODOT 709.14.

2.2.2 Welded Wire Fabric

Welded wire fabric (WWF) shall meet the requirements of ODOT 709 and ASTM A 185 and shall be delivered to the project site as flat sheets; any rolled (WWF) shall be rejected.

2.2.3 Fiber Reinforcing

Synthetic fiber reinforcing shall be polyester (P.E.T.) monofilament with a specific gravity of 1.34, fiber length of 38.1 mm and mixed at a rate of 0.89 kilograms per cubic meter of concrete. This type of reinforcing shall be used for temperature and shrinkage control only.

2.2.4 Dowels

Dowels located in expansion or construction joints in concrete pavements, slabs and/or as located on the Contract drawings shall be smooth round mild steel bar stock with end cap, 457 mm long and 25.4 mm in diameter.

2.3 EXPANSION JOINT MATERIAL

2.3.1 Shrinkage Compensating Concrete

All expansion joint material in contact with shrinkage compensating concrete shall be 12.7 mm thick, extend the full depth of the concrete section and have a maximum compression of 1.76 kilograms per square centimeter at 50% deformation and comply with ASTM D 1621 and/or ASTM D 3575.

2.3.2 Non-Shrinkage Compensating Concrete

Expansion joint material in contact with non-shrinkage compensating concrete shall be 12.7 mm thick, extend the full depth of the concrete section, located as shown on the Contract drawings and comply with ODOT 705.03 Preformed Fillers.

2.4 FORM MATERIALS

Forms shall be of wood, steel or other material approved by the COTR, and shall conform to ACI 318.

Form release agent shall conform to Corps of Engineers COE 204.

2.5 CURING AND SEALING COMPOUND

Curing and sealing compound shall conform to ODOT 705.07 Type A and ASTM C 309.

PART 3 EXECUTION

3.1 GENERAL

Concrete shall be constructed in accordance with ACI 318 Building Code, ACI 305R, ACI 306R, ACI 316R, and ODOT 511.

3.2 FORM WORK

Forms shall be true to line and grade, mortar tight and sufficiently rigid to prevent any observable deformation under the load resulting from the wet concrete.

Form surfaces for permanently exposed faces shall be smooth, free from irregularities, dents, sags or holes. Exposed joints, corners and edges shall be chamfered 19.05mm. Depth of embedment of form ties shall be no less than that required for reinforcing per ACI 318.

Forms for exposed surfaces and surfaces exposed to freezing conditions shall have applied a non-staining release agent.

Forms shall be stripped carefully to avoid damaging the concrete and shall not be removed prior to 24 hours after casting, unless directed to by the COTR.

3.2.1 Shrinkage Compensating Concrete

The slab formwork must allow for the expansive action of this type of concrete. A formed edge must have the brace stakes or pins loosened immediately after the concrete has set to permit the concrete to expand. Edges that abut adjacent rigid construction shall have the proper expansion joint material applied prior to casting.

3.3 REINFORCING

3.3.1 Steel Reinforcing

The requirements of ODOT 509 shall be strictly adhered to.

Reinforcing bar and/or welded wire fabric (WWF) shall be free of loose, flaky rust and scale as well as any other deleterious materials such as oil, grease or paint that would reduce the bond with the concrete. WWF shall be delivered and installed as flat sheets only.

Epoxy coated bar shall be installed as shown on the Contract drawings and according to ODOT 509.10.

Reinforcement shall be secured in the formwork or on the subgrade surface by ties and chairs of sufficient number and strength to prevent movement during placement and casting operations.

3.3.2 Fiber Reinforcing

Fiber reinforcing shall be added to the concrete in the truck at a rate of 0.89 kilogram per cubic meter and according to the manufacturers instructions.

3.4 CONCRETE CASTING

A plasticizing agent should be added to ease casting; water shall not be added for this purpose.

Concrete shall be placed within 90 minutes of being mixed if no set-retarding admixture is used. Loads received after this time will be rejected.

Concrete shall be consolidated and worked uniformly into corners and around all reinforcing by rodding, vibrating, handspading and tamping in such a way as to prevent segregation.

3.5 FINISHING

3.6 CURING AND PROTECTION

Fresh concrete shall be cured in accordance with ODOT 511 Method (b) using

an approved liquid membrane curing compound. Traffic on new concrete will be restricted for a minimum of 14 days to allow proper curing to occur.

3.7 FIELD TESTING

Quality control and field testing during construction is the responsibility of the Contractor.

Specimens shall be tested for compressive strength at 7 days and at 28 days.

-- End of Section --

SECTION 02514

ASPHALT PAVEMENT

04/97

PART 1 GENERAL

1.1 SUMMARY

The work under this section shall include all labor, services, equipment, materials and tools necessary to install bituminous asphalt concrete pavement according to the Contract drawings and as specified herein. The work includes preparing the subgrade surface, installing an aggregate base course, a bituminous aggregate base course, a bituminous aggregate intermediate course, an asphalt concrete wearing course, and joints abutting other construction.

The bituminous asphalt pavement shall be installed in the full depth replacement areas and in the new pavement areas as shown on the Contract drawings.

1.2 REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 247 (1981; Rev 1986) Glass Beads Used in
Traffic Paint

AASHTO M 248 (1986) Ready Mixed White and Yellow
Traffic Paints

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT 203 (1997) Roadway Excavation and Embankment;
and Subparts as Specified

ODOT 301 (1997) Bituminous Aggregate Base; and
Subparts as Specified

ODOT 304 (1997) Aggregate Base; and Subparts as
Specified

ODOT 401 (1997) Plant Mix Pavement General; and
Subparts as Specified

ODOT 402 (1997) Asphalt Concrete; and Subparts as
Specified

ODOT 404 (1996) Asphalt Concrete; and Subparts as
Specified

ODOT 407 (1997) Tack Coat; and Subparts as Specified

| | |
|----------|---|
| ODOT 408 | (1997) Prime Coat; and Subparts as Specified |
| ODOT 411 | (1997) Stabilized Crushed Aggregate; and Subparts as Specified |
| ODOT 641 | (1997) Pavement Marking - General; and Subparts as Specified |
| ODOT 642 | (1997) Traffic Paint; and Subparts as Specified |
| ODOT 705 | (1997) Concrete Pavement Incidentals; and Subparts as Specified |

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01, Data

Mix Designs for each bituminous concrete mixture shall be submitted for approval for each type. Compliance with ODOT material specifications is mandatory.

SD-07, Schedules

Construction Equipment List for all major pieces of equipment to be used to execute this specification shall be submitted by the Contractor.

SD-13, Certificates

Certificates of Compliance for the following items shall be submitted in accordance with the applicable reference standards and specifications contained within this section:

Coarse Aggregate Mineralogy and Gradation
Fine Aggregate Mineralogy and Gradation
Asphalt Cement

PART 2 PRODUCTS

2.1 AGGREGATE BASE

The aggregate base shall consist of ODOT 304 aggregate base except that aggregate shall only consist of limestone or dolomite. Slag shall no be permitted for any purpose. All other requirements apply. Thickness shall be as shown on the Contract drawings.

2.2 BITUMINOUS AGGREGATE BASE

The bituminous aggregate base course shall consist of ODOT 301 bituminous aggregate base. All requirements found in ODOT 401 apply except that the aggregate shall consist only of limestone or dolomite. Slag shall not be permitted for any purpose. Thickness shall be as shown on the Contract drawings.

2.3 INTERMEDIATE COURSE

The intermediate course shall consist of ODOT 402 asphalt concrete. All requirements found in ODOT 401 apply except that the aggregate shall consist only of limestone or dolomite. Slag shall no be permitted for any purpose. Thickness shall be as shown on the Contract drawings.

2.4 WEARING COURSE

The wearing course shall consist of ODOT 404 asphalt concrete. All requirements found in ODOT 401 apply except that the aggregate shall consist only of limestone or dolomite. Slag shall not be permitted for any purpose. Thickness shall be as shown on the Contract drawings.

2.5 TACK COAT

The bituminous tack coat shall be rapid curing cut-back asphalt conforming to designation RC-70, as specified in ODOT 407.

2.6 JOINT SEALANT

The bituminous joint sealant shall be ODOT 705.04 hot-applied crack and joint sealer.

2.7 PRIME COAT

The bituminous prime coat shall comply with the requirements of ODOT 408, except that cover aggregate, where specified on the contract drawings, shall no be slag.

2.8 STABILIZED AGGREGATE SHOULDER

The stabilized aggregate shoulder, where specified on the Contract drawings, shall comply with ODOT 411, except that slag shall not be permitted. Limestone or dolomite are the only acceptable materials.

2.9 PAVEMENT MARKING

2.9.1 Paint

Paint shall conform to AASHTO M 248, Type S. Parking lanes, stop lines, crosswalks, and traffic lanes shall be white. Center lines shall be yellow.

2.9.2 Reflective Beads

Glass beads for reflectorized paint shall conform to AASHTO M 247, Type 1.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

All earthwork associated with establishing the pavement subgrade shall conform to ODOT 203 as modified by these specifications.

The trenches shall be backfilled and compacted to subgrade elevation (no less than 360 mm below finished grade) as specified elsewhere.

The subgrade surface shall be free of all loose materials prior to placing subbase stone as per subpart entitled, "AGGREGATE BASE."

All milled or planed surfaces shall be thoroughly cleaned of all loose material, dust and water by brooming and vacuuming.

3.1.1 Grading and Compaction

Final subgrade line grade and compaction shall be as shown on the Contract Drawings.

The compacted subgrade surface must be approved by the Contracting Officers Technical Representative (COTR) prior to placing any materials covered by these specifications.

3.1.2 Proof Rolling

The subgrade surface under pavement repair locations shall be compacted using powered compaction equipment approved by the COTR and, at the direction of the COTR, demonstrate that the subgrade surface is suitably compact. This must be done in the presence of the COTR in order to receive approval to place paving materials.

3.1.3 Replacement of Unsuitable Subgrade Material

Any subgrade material judged by the COTR to be soft, organically contaminated or unsuitable shall be removed to a maximum depth of 300 mm and replaced, at the direction of the COTR, with rolled and compacted granular fill material approved by the COTR. It will be paid for at the Contract unit price for that material unless the COTR determines that the unsuitable material was the result of Contract negligence, in which case the Contractor will pay for repair.

3.2 AGGREGATE BASE COURSE

Aggregate base course material shall be placed according to the requirements of ODOT 304 Aggregate Base. Maximum lift thickness will be 150 mm prior to compaction with vibratory equipment. Compaction shall be done with adequate power-driven vibratory compactors approved by the COTR. If the NASA field inspector determines that adequate compaction is not being accomplished, the Contractor shall replace the compaction equipment at no cost to the Government. It is recommended that back-hoe mounted hydraulic vibratory plates be employed for this purpose.

3.3 BITUMINOUS AGGREGATE BASE COURSE

Bituminous aggregate base course material shall be placed according to the requirements of ODOT 301. Maximum lift thickness shall be 75 mm. Joints between adjacent and underlying lanes of placed asphalt material shall be lapped a minimum of 610 mm. All other requirements of ODOT 401 shall be followed. Compaction shall be in accordance with ODOT 304.05 and rollers shall consist of type specified in ODOT 304.05. Variation shall only be permitted by the COTR and shall require compaction with a back-hoe mounted hydraulic vibratory plate.

3.4 INTERMEDIATE COURSE

Intermediate course shall be placed according to the requirements of ODOT 402 Asphalt Concrete. Maximum compacted lift thickness shall be 75 mm. Joints between adjacent and underlying lanes of placed asphalt material shall be lapped a minimum of 610 mm. All other requirements of ODOT 401 shall be followed. Compaction shall be in accordance with ODOT 401.14 and rollers shall consist of type specified in ODOT 401.11. Variation shall only be permitted by the COTR and shall require compaction with a back-hoe mounted hydraulic vibratory plate.

3.5 WEARING COURSE

Wearing course shall be placed according to the requirements of ODOT 404 Asphalt Concrete. Maximum compacted lift thickness shall be 75 mm. Joints between adjacent and underlying lanes of placed asphalt material shall be lapped a minimum of 610 mm. All other requirements of ODOT 401 shall be followed. Compaction shall be in accordance with ODOT 401.14 and rollers shall consist of type specified in ODOT 401.11. Variation shall only be permitted by the COTR and shall require compaction with a back-hoe mounted hydraulic vibratory plate.

3.6 TACK COAT

ODOT 407 Tack Coat shall be applied between cold joints, as required by ODOT 401, at a rate of 1.2 liter per square meter.

3.7 BUTT JOINTS

All applicable requirements found in ODOT 401 shall be followed.

The Contractor shall line out the pavement repair areas in roughly rectangular zones using chalk lines followed by water-soluble spray paint. All lines shall be straight, neat, and true. Small, isolated "islands" of original pavement within zones of repaired pavement shall be removed. All pavement repair areas shall be specifically approved by the NASA field inspector and/or COTR prior to commencing work on that area. Modifications to the line work shall be made at their direction.

All butt joints with adjoining pavements shall be saw cut a minimum of 100 mm depth if not indicated on the contract drawings. All pavement, subbase stone and subgrade soil shall be removed to a depth of 360 mm.

Butt joints shall be executed at all locations where new asphalt pavement

will abut existing asphalt or concrete pavements and as shown on the Contract drawings.

3.7.1 Saw Cutting

A line shall be marked on the existing pavement that will designate the limits of new asphalt pavement installation. This line shall be saw cut neat and true to a minimum depth of 100 mm if not indicated on the drawing, or if indicated as shown on the Contract Drawings with a pavement saw. Water shall be used as the cutting medium to prevent dust. All materials designated for demolition shall be removed and disposed of properly.

3.7.2 Tack Coat

ODOT 407 shall be applied to the exposed vertical surface of the existing pavement. The rate of application will be 1.2 liters per square meter of vertical surface area.

3.7.3 Joint Sealant

ODOT 705.04 shall be applied to the joint following placement of all pavement materials. Joint sealant shall not be placed on joints between cast or ductile iron products (e.g. manhole cover and rim).

3.7.4 Contact With Curbs, Manholes and Other Surface Fixtures

Contact surfaces abutting the asphalt pavement shall be coated with ODOT 407 Tack Coat no higher than the finished grade of the pavement prior to placing the pavement materials.

ODOT 705.04 Hot-Applied Joint Sealant shall be applied to the joint following placement of the pavement materials.

3.8 PRIME COAT

Bituminous prime coat shall be applied according to the requirements of ODOT 408 at a rate of 1.8 liters per square meter.

3.9 HAND PLACING ASPHALT PAVEMENT

In areas where the use of machine spreading is not practical, the asphaltic materials shall be spread and finished by the use of heated hand tools. Compaction will be done with a pavement roller where possible or a hand compactor where not possible.

All specified subgrade compaction requirements apply.

Aggregate base shall be compacted using pavement roller or powered hand tamper.

The asphalt mixtures shall be dumped on approved dump boards and distributed into place from the dump boards in a uniformly loose layer of a thickness that will, when compacted, conform to the required grade and thickness. The mixture will be dumped no faster than the shovelers and

rakers can spread it properly. Any improperly placed pavement will, at the direction of the COTR, be removed and replaced at the Contractor's expense.

3.10 ACCEPTANCE PROVISIONS

At the discretion of the COTR composition, density, surface smoothness and thickness of the completed pavement section will be tested for compliance with specifications. Any substandard areas will be completely removed and replaced at the Contractor's expense.

Surface smoothness tolerance specifications found in ODOT 401 will be adhered to strictly. Any pavement found not to comply shall be removed, replaced and regraded at the Contractor's expense.

3.11 PAVEMENT MARKING

Pavement marking shall comply with the requirements of ODOT 641 and ODOT 642 and shall be replaced where removed or worn by Contractor activity. Placement shall be in accordance with the Ohio Manual of Uniform Traffic Control Devices (OMUTCD).

-- End of Section --

SECTION 02524

CONCRETE WALKS, RAMPS, CURBS AND SLABS

06/92

PART 1 GENERAL

1.1 SUMMARY

The work under this section includes all labor, services, equipment, materials and tools necessary to install concrete walk(s), concrete curb(s), concrete handicap ramp(s), concrete pavement slab(s), at location(s) shown on the Contract drawings(s) and as specified herein. The work includes subgrade preparation, installation of a limestone aggregate base, formwork, casting and curing the specified concrete item(s).

1.2 REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

| | |
|--------------|--|
| AASHTO M 182 | (1960; Rev 1974) Burlap Cloth made from Jute or Kenaf |
| AASHTO T 260 | 1984, Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials |

AMERICAN CONCRETE INSTITUTE (ACI)

| | |
|-----------|---|
| ACI 223 | (1983) Standard Practice for the Use of Shrinkage-Compensating Concrete |
| ACI 305R | (1989) Hot Weather Concreting |
| ACI 306R | (1988) Cold Weather Concreting |
| ACI 318 | (1989; 318R-89) Building Code Requirements for Reinforced Concrete |
| ACI SP-66 | (1988) ACI Detailing Manual |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|------------|--|
| ASTM A 185 | (1988) Welded Steel Wire Fabric for Concrete Reinforcement |
| ASTM C 143 | (1990) Slump of Portland Cement Concrete |
| ASTM C 171 | (1969; R 1986) Sheet Materials for Curing Concrete |
| ASTM C 172 | (1990) Sampling Freshly Mixed Concrete |

| | |
|-------------|--|
| ASTM C 231 | (1989a) Air Content of Freshly Mixed Concrete by the Pressure Method |
| ASTM C 309 | (1989) Liquid Membrane-Forming Compounds for Curing Concrete |
| ASTM C 31 | (1990) Making and Curing Concrete Test Specimens in the Field |
| ASTM C 39 | (1986) Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C 94 | (1990) Ready-Mixed Concrete |
| ASTM D 1621 | 1979 Test Method for Compressive Properties of Rigid Cellular Plastics |
| ASTM D 3575 | 1984 Test Method for Flexible Cellular Materials made from Olefin Polymers |

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

| | |
|----------|--|
| ODOT 203 | (1997) Roadway Excavation and Embankment; and Subparts as Specified |
| ODOT 451 | (1997) Reinforced Portland Cement Concrete Pavement; and Subparts as Specified |
| ODOT 499 | (1997) Concrete General; and Subparts as Specified |
| ODOT 509 | (1997) Reinforcing Steel; and Subparts as Specified |
| ODOT 511 | (1997) Concrete for Structures; and Subparts as Specified |
| ODOT 608 | (1997) Walks, Curb Ramps and Steps; and Subparts as Specified |
| ODOT 609 | (1997) Curbing; and Subparts as Specified |
| ODOT 701 | (1997) Hydraulic Cement; and Subparts as Specified |
| ODOT 705 | (1997) Concrete Pavement Incidentals; and Subparts as Specified |
| ODOT 709 | (1997) Reinforcing Steel; and Subparts as Specified |

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330,

"Submittals," in sufficient detail to show full compliance with the specification:

SD-01, Data

Mix Designs (Contractor and Job) shall be submitted for approval for each concrete class. The design for concrete properties shall equal or exceed the specified design properties. following items:

SD-06, Instructions

Manufacturers Instructions for all products used shall be submitted, including any special instructions for equipment installation, for approval prior to use. Special notices shall detail all pedestrian impedances, hazards and safety precautions.

SD-13, Certificates

Certificates of Compliance shall be submitted for the following items demonstrating conformance with the referenced specifications contained in this section. Certificates must contain project name and Contract number, date, name of Contractor, name of concrete testing service, source and mineralogy of aggregates, complete catalog information for all manufactured products proposed and test results. The items are:

Reinforcing steel
Form materials
Curing and sealing materials
Joint materials
Concrete materials
Concrete mix design

SD-14, Samples

Samples of each concrete mix shall be submitted in accordance with the paragraph entitled "Quality Control During Construction" of this section.

1.4 LABORATORY AND FIELD SAMPLING AND TESTING SERVICE

Sampling and testing services shall be provided by the Contractor at the direction of the Contracting Officers Technical Representative (COTR). The testing service agency shall be approved prior to commencing construction. The field testing shall be done to determine conformance with reference specifications and for quality control.

1.4.1 Laboratory Testing

Laboratory testing shall consist of running compressive strength tests on concrete cylinders, prepared in the field, according to ASTM C 39.

1.4.2 Field Testing and Quality Control During Construction

Concrete shall be sampled and tested at the direction of the COTR and as follows:

| <u>REQUIREMEN</u> | <u>TEST METHO</u> | <u>NUMBER OF TESTS</u> |
|----------------------|-------------------|--|
| Sampling | ASTM C 172 | As required for each test. |
| Slump one | ASTM C 143 | One for each concrete load; each time water or an admixture is added to the mix. |
| Air content | ASTM C 231 | One at the point of delivery for each load and one for each set for compressive strength test cylinders. |
| Compression test | ASTM C 31 | One set of four (4) standard cylinders for each compressive strength test for each load at 7, 14, and 28 days. One cylinder is a spare. |
| Concrete temperature | | Hourly when air temperature is 4.49 degrees C and below or 2.67 degrees C and above and each time a set of compres- sive-test specimens is made. |

PART 2 PRODUCTS

2.1 CONCRETE

All Code requirements contained within ACI 318, ACI 305R, ACI 306R, and ACI SP-66 shall be strictly adhered.

The general provisions contained in ODOT 499 apply to this specification as modified herein:

Minimum 28 day compressive strength of 281.2 kilograms per square centimeter.

Maximum chloride ion content of 0.30% by weight of cement in mix per cubic yard according to AASHTO T 260.

Air entrainment 5% to 7% at point of placement.

Maximum delivered slump of 51 mm without plastisizers added; 208 mm after an approved superplastisizer is added; 254 mm with an approved batch plant added high-range water reducing admixture producing a rheoplastic concrete. Water shall no be added at the job site for the purpose of easing casting or finishing.

Maximum water-cement ratio of 0.40.

Course aggregate shall be limestone or dolomite only.

Mix water shall be potable.

Ready mix concrete shall conform to ASTM C 94.

2.1.1 Shrinkage Compensating

The above specifications apply to this item and shall include the following:

Shrinkage compensating concrete shall be Type , constructed according to ACI 223 and ODOT 701.08.

Minimum cement content per cubic meter is 305.5 kilograms.

Maximum water-cement ratio can be increased to 0.50.

Maximum delivered slump can be increased to 102 mm.

2.1.2 Reinforcing Bar

Reinforcing bars shall meet the requirements of ODOT 509.

2.1.3 Welded Wire Fabric

Welded wire fabric (WWF) shall meet the requirements of ODOT 709 and ASTM A 185 and shall be delivered to the project site as flat sheets; any rolled (WWF) will be rejected.

2.2 FORM MATERIALS

Forms shall be of ample strength to resist any deformation during concrete casting and to remain in vertical and horizontal alignment until concrete has hardened. Forms shall be straight (except where a curve is detailed on the Contract drawings, in which case a smooth, even radius shall be executed), free of distortion or defects and extend the full depth of the concrete. At the direction of the COTR, all unacceptable forms shall be removed and replaced at the Contractors expense.

Form releasing agent shall be used and will be a clear compound that will not discolor or damage the concrete surface.

2.3 CURING AND SEALING MATERIALS

2.3.1 Curing Mats

Mats shall consist of a filling material of cotton batts, covered with unsized cloth tufted or stitched to maintain the shape and stability, as approved.

Burlap cloth shall be made from jute or kenaf and shall be plain weave, weighing 10 ounces per square yard, conforming to AASHTO M 182, Class 3.

2.3.2 Moisture-Retaining Cover

The cover shall be fiber-reinforced, two-ply, nonstaining, white waterproof paper; 4-mil, white, opaque polyethylene film; or 4-mil burlap-polyethylene sheet, conforming to ASTM C 171.

2.3.3 Liquid Membrane-Forming Compounds

Compounds shall be spray applied, white pigmented, conforming to ASTM C 309, and ODOT 705.07.

2.4 JOINT MATERIALS

2.4.1 Preformed Filler

Preformed expansion joint filler material shall conform to ODOT 705.03, except as noted below:

All expansion joint material in contact with shrinkage compensating concrete shall be 12.7 mm thick, extend the full depth of the concrete section and have a maximum compression of 1.76 kilograms per square centimeter at 50% deformation and comply with ASTM D 1621 and or ASTM D 3575.

2.4.2 Joint Sealer

Hot-applied joint sealer shall conform to ODOT 705.04.

2.5 AGGREGATE BASE

Aggregate base shall consist of #57 limestone. Slag shall not be permitted. Limestone is the only acceptable material.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

All earthwork associated with establishing the subgrade shall conform to ODOT 203 as modified by these specifications.

3.1.1 Grading and Compaction

Final subgrade line, grade and compaction shall be as shown on the Contract drawings.

The compacted subgrade surface must be approved by the COTR prior to placing any construction materials.

3.2 FORM WORK

Forms shall extend the full thickness of concrete walks as specified on the Contract drawings.

3.3 CONCRETE WALK

The applicable sections contained in ODOT 608 Walks, Curb Ramps and Steps shall be adhered to except as modified herein.

3.3.1 Subgrade

The subgrade surface shall be proof rolled with a paving roller or smooth-wheel vibratory compactor of at least 1814 kg weight.

3.3.2 Aggregate Base

The aggregate base shall consist of a minimum of 75 mm of #57 limestone or dolomite, placed and spread uniformly and compacted with a paving roller or smooth-wheel vibratory compactor of at least 1814 kg weight.

3.3.3 Concrete

Cast in place concrete shall be placed in the location(s) shown on the Contract drawing(s).

Concrete shall be unreinforced and shall be a minimum 127 mm in depth.

Sidewalk width shall be 1.524 m.

Tooled construction joints shall be placed every 1.524 m of walk and as shown on the Contract drawings.

Expansion joints shall be located at sidewalk terminations, every 6.1 m of walk as shown on the Contract drawings and against adjacent structures.

Broom finish shall be applied after bleed water has disappeared.

Concrete curing and sealing compound shall be applied to all exposed concrete surfaces.

3.4 HANDICAP RAMPS

All specification covering sidewalk installation as per paragraph entitled "Concrete Walk" apply to this section. Location(s) of handicap ramps are as shown on the Contract drawing(s).

3.5 CONCRETE CURBS

Concrete curbs shall be constructed at the location(s) shown on the Contract drawing(s) and according to the requirements of ODOT 609 Curbing as modified herein.

Locations where new curbs abut existing curbs shall be saw cut neat and true and the full depth of the existing curb.

Curbs shall be constructed of cast-in-place concrete, and shall have an expansion joint every 6.1 m and at butt joints with other construction.

3.6 PAVEMENT SLABS

Pavement slab(s) shall be constructed according to the plan(s) and profile(s) shown on the Contract drawing(s); and in accordance with the requirements of ODOT 451.

3.7 CURING

Concrete curing shall follow the requirements of ODOT 511.

3.8 INCIDENTALS

Items under this section include all other slabs on grade, surface fixture protection slabs, equipment mounting pads and any other non-structural concrete items.

Location and design of these items are as shown on the Contract drawing(s).

Concrete surface shall be broom finished.

-- End of Section --

SECTION 02536

SANITARY SEWERAGE SYSTEMS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|-------------|--|
| ASTM C 150 | (1995) Standard Specification for Portland Cement |
| ASTM C 425 | (1991) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings |
| ASTM C 443 | (1994) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets |
| ASTM C 443M | (1994) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric) |
| ASTM C 478M | Standard Specification for Precast Reinforced Concrete Manhole Sections |
| ASTM C 564 | (1995) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| ASTM C 700 | (1991) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated |
| ASTM C 76M | (1995) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe |
| ASTM C 828 | Low-Pressure Air Test of Vitrified Clay Pipe Lines |
| ASTM D 1869 | (1994) Rubber Rings for Asbestos-Cement Pipe |
| ASTM D 3034 | (1994) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |

ASTM F 1417 (1992) Standard Test Method for
Installation Acceptance of Plastic Gravity
Sewer Lines Using Low-Pressure Air

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT 703 (1997) Aggregate; and Subparts as Specified

ODOT 711 (1997) Structural Steel and Structure
Incidentals; and Subparts as Specified

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330,
"Submittals," in sufficient detail to show full compliance with the
specification:

SD-04 Drawings

Installation Drawings for the following items shall be submitted
showing complete detail, both plan and sideview details with
proper layout dimension and elevations.

SD-04 Drawings

As-Built Drawings for the complete Sanitary Sewer System.

SD-08 Maintenance of Flow

A Detailed Plan shall be submitted for maintaining the flow of
sewage for each segment prior to the start of work. The following
items shall be noted in the plan:

Proposed Schedules
Methods
Materials
Equipment

SD-09 Reports

Test Reports for the following items shall be submitted.
Compaction and density test shall be in accordance with Section
02225, "Excavation, Backfilling, and Compacting for Utilities."

SD-09 Reports

Inspection Reports for Daily Activities during the installation of
the sanitary system shall be submitted. Information in the report
shall be detailed enough to describe location of work and amount
(footage) laid.

SD-13 Certificates

Certificates of Compliance for the following items shall be submitted in accordance with the applicable reference standards and description of this section:

Precast Reinforced Concrete Grade Rings Manholes
Precast Reinforced Concrete Manhole Sections
Concrete Aggregates
Portland Cement
Concrete Grout Mix Design
Rubber Gaskets
Pipe
Pipe Connection Device
Frames and Covers
Manhole Steps

SD-18 Records

Record of Existing Conditions shall be submitted after a thorough inspection of the area by the Contractor in the presence of the Contracting Officer.

PART 2 PRODUCTS

2.1 PRECAST REINFORCED CONCRETE GRADE RINGS FOR MANHOLES

Precast Reinforced Concrete Grade Rings shall conform to ASTM C 478M, Grade SW.

2.2 CEMENT MORTAR

Mortar shall consist of 1 part portland cement and 2 parts fine sand with enough water to produce mortar of the proper consistency for the type of joint.

2.3 CONCRETE AGGREGATES

Aggregates shall conform to ODOT 703 except that granulated slag (ODOT 703.8) shall not be permitted.

2.4 RUBBER GASKETS

Rubber gaskets shall conform to ASTM C 443M, ASTM C 564, ASTM D 1869, and ASTM C 443M.

2.5 PIPE

Pipe shall be as follows:

Vitrified clay pipe and fittings shall conform to ASTM C 700, extra strength, bell-and-spigot type. Joints shall be in accordance with ASTM C 425.

Concrete pipe and fittings shall conform to ASTM C 76M and shall be the bell-and-spigot type. Joint gaskets shall conform to ASTM C 443M.

Polyvinyl chloride (PVC) pipe and fittings shall conform to ASTM D 3034, Cell Classification 12454-B.

2.6 PORTLAND CEMENT

Cement shall conform to ASTM C 150, Type 1.

2.7 HYDRAULIC CEMENT

Hydraulic cement shall be Sono Plug or Water Plug.

2.8 FRAMES AND COVERS

Ductile iron frames and solid covers shall be in accordance with ODOT 711.13.

Deviations in standard castings shall be acceptable only when prior approval has been granted.

"SANITARY" at least 50 millimeter high shall be cast into covers so as to be conspicuously visible.

2.9 JOINTING

Cement mortar shall not be used as a pipe-jointing material. Hydraulic cement shall be used at manhole joints and pipe joints approved by the COTR.

Pipe joints shall be sealed with:

A rubber gasket configuration conforming to ASTM C 478M, as recommended by the pipe manufacturer for the particular type of pipe joint. Gaskets shall be installed to provide a tight fit. Rubber gaskets may be used with clay pipe, concrete pipe, and PVC pipe.

2.10 MANHOLES

2.10.1 Construction

Manholes shall be constructed of reinforced precast-concrete rings conforming to ASTM C 478M with ductile iron frames and covers. Frames and covers shall be bolted down and as necessary. Frames and covers shall be set so that the top of the cover is 100 millimeter higher than finished grade, where no pavement exists. Where pavement does exist, frames shall be flush with surface. Invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.

2.10.1.1 Invert Channels

Invert channels shall be formed directly in the concrete of the manhole base. Flooring of the manhole outside the channels shall be smooth and shall slope toward the channels, no less than 25 millimeter per 300 millimeter nor more than 50 millimeter per 300 millimeter. The free drop inside the manholes shall not exceed 760 millimeter measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels. Drop manholes shall be constructed whenever the free drop would be greater than 760 millimeter.

2.10.1.2 Concrete

Concrete used in manholes shall have a compressive strength of not less than 21 Megapascal after 28 days and shall be composed of not less than 7-1/2 bags of portland cement per cubic meter. Coarse aggregate shall be used in the greatest amount consistent with required workability. The foregoing requirements apply to concrete in precast rings, segmental blocks, and concrete poured in place. Concrete rings shall conform to ASTM C 76M, except that the length of sections may be shorter as conditions require. Wall thicknesses shall be not less than 127 millimeter nor less than 1/12 the diameter of the manhole for either vertical walls or cone sections and shall be reinforced with not less than 3 square millimeter of steel per 300 millimeter of height. Joints between precast rings shall be have resilient gaskets conforming to ASTM C 443.

2.10.1.3 Steps

Steps shall be as detailed on the contract drawings and shall conform to ODOT 711.31, Reinforced Propylene Plastic Manhole Steps.

2.10.1.4 Jointing and Plastering

Mortar for jointing and plastering shall consist of 1 part portland cement and 2 parts fine sand. For brickwork, lime may be added to the mortar in the amount of not more than 25 percent of the volume of cement. Joints shall be completely filled, smooth, and free from surplus mortar on the inside of the manhole.

2.11 CONNECTIONS TO STRUCTURES

New manholes shall have predesigned factory installed rubber boots with Stainless Steel (S.S.) band pipe connectors. The pipe inserted in the opening around the pipe shall be neatly and permanently closed (water tight) with non-shrinking and non-corrosive grout.

Pipes connecting to an existing manhole without a stub, shall be with a water tight connection. Sewers shall be designed to enter an existing manhole at an elevation so that core bore is not any closer than 150 millimeters to any manhole joint.

PART 3 EXECUTION

3.1 LAYOUT AND QUALITY CONTROL MEASUREMENTS

A Professional Surveyor registered in the State of Ohio shall perform all

construction layout and quality control measurements. Layout shall be performed in metric dimensions and be accurate enough to achieve the construction tolerances. The Contractor shall provide copies of the Surveyor's field book to the COTR. The Contractor shall not employ a Surveyor or his firm who is the current NASA GRC Support Service Contractor.

3.2 LOCATION

Where the location of the sewer is not clearly defined by dimensions, the sewer shall be laid not closer than 3050 millimeter horizontally to a water supply main or service line except that where the bottom of the water pipe will be at least 300 millimeter above the top of the sewer pipe, the horizontal spacing shall be a minimum of 1830 millimeter. Water lines shall be above sewage force mains.

Where gravity-flow sewers cross above waterlines, the sewer pipe for a distance of at least 3000 millimeter each side of the crossing shall be ductile iron, pipe and without joints closer horizontally than 900 millimeter to the crossing, or the sewer pipe shall be fully encased in concrete. Thickness of the concrete, including that at the pipe joints, shall be not less than 100 millimeter.

3.3 EXCAVATION AND BACKFILL

Excavation, backfill, and removal of unsatisfactory materials shall be in accordance with Section 02225, "Excavation, Backfilling, and Compacting for Utilities," and 02311, "Excavating, Backfilling, and Compacting for Structures."

3.4 PIPE LAYING

Bottom of trench shall be shaped to give uniform circumferential support to the lower fourth of each pipe. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid true to line and grade in a manner to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. Interior of the sewer shall be cleared of superfluous materials at all times. Where cleaning after laying is difficult, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. When the maximum width of the trench at the top of the pipe is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, such bedding as may be required to satisfactorily support the added load of the backfill. Trenches shall be kept free from water until the pipe-joining material has set. Pipe shall not be laid when the condition of the trench or the weather is unsuitable for such work. When work is not in progress, open ends of pipe and fittings shall be closed to prevent intrusion of foreign materials.

3.5 CONSTRUCTION TOLERANCES AND QUALITY CONTROL

Invert elevations shall be constructed to within 30 millimeters of the elevation required by the contract drawings. Manholes shall be located

horizontally within plus or minus 180 millimeters of the location on the contract drawings. The Contractor shall construct the sewer between two manholes within 5 percent of the percent grade stated on the construction drawings. The most stringent requirement shall apply.

3.6 INFILTRATION AND EXFILTRATION

Leakage shall not exceed a rate of 18.5 liter per millimeter of pipe diameter per kilometer per day of sewer for any section between successive manholes. When infiltration appears excessive, the amount of leakage shall be measured by a suitable weir or other device. When the determination of infiltration is not practicable because of dry trench conditions, exfiltration tests shall be made by filling the sewer between successive manholes with water to the top of the outlet of the upper manholes. Amount of water required to maintain the pipe full for the required test period shall be measured and the rate of leakage determined. When leakage exceeds the maximum amount, an approved correction shall be made. Both measurement and correction shall be made at no additional cost to the Government.

3.7 WYE BRANCHES

Commercially manufactured wye branches shall be installed where sewer connections are necessary. Cutting into pipe for connections shall not be done except as approved. When conditions are such that the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete or supported on a concrete cradle as directed. Concrete required due to faulty construction methods or negligence of the Contractor shall be installed at no additional cost to the Government.

3.8 CONNECTIONS TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made in such manner that the finished work shall conform as nearly as practicable to the applicable requirements for new manholes.

3.9 GRADING

Grading shall be performed in accordance with Section 02225, "Excavation, Backfilling, and Compacting for Utilities."

3.10 TESTING

A. General

1. Tests may be conducted on completed pipe line or any completed portion that can be isolated from other sections previously tested or not complete.

B. Testing Manholes

1. After the filled manhole has been allowed to stand for 24 hours, no loss of water will be permitted in a four (4) hour period.

2. Air testing of manholes is required. Contractor shall submit proposed procedures to COTR for approval.

C. Low Pressure Air Test

1. The Contractor shall perform an air test on sewers.
2. Approval of COTR is required.
3. Air Test procedure
 - a. Plug all pipe outlets with suitable test plugs in section to be tested.
 - b. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
 - c. After an internal air pressure of 4.0 psig is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
 - d. After the two minute period, disconnect the air supply.
 - e. When pressure decreases to 3.5 psig, start timing with a stop watch.
 - f. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig.
 - g. Minimum permissible pressure holding times shall be as prescribed in ASTM C 828, Low-Pressure Air Test of Vitrified Clay Pipe Lines; in ASTM F 1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air; or as recommended by the manufacturer for the type of piping materials being tested.
4. All air tests shall be conducted with the utmost safety precautions, including by not limited to:
 - a. Bracing all plugs securely.
 - b. Not allowing personnel in manholes during testing.
 - c. Installing a pressure-relief system operative at 0.7 kilograms per square centimeter.

F. Deflection Test

1. A deflection test shall be made by pulling through the sewer a rigid ball or mandril having a diameter equal to 95% of the inside diameter of the pipe.
2. Deflection tests shall be performed no sooner than 60 days

following completion of backfill.

3. All plastic pipe shall be tested for deflection.
4. Maximum ring deflection of pipe when backfilled shall be equal to or less than 5 percent of average inside diameter.
5. A copy of diameter record shall be submitted to the Engineer.
6. Any pipe showing deflections in excess of 5%, sixty (60) days after installation, shall be replaced at no cost to the Owner.

3.11 NASA QUALITY ASSURANCE MEASUREMENTS

During the construction, the Contractor shall allow and make provisions for NASA to survey the work in progress. The Contractor shall provide access for the NASA GRC support service contractor's surveyor to enter the construction site, set up survey instruments, and take measurements. The purpose of these measurements is to perform quality assurance measurements for the location and elevation of the installed sewer and manholes. The Contractor remains responsible to perform quality control measurements throughout construction as required.

3.12 AS-BUILT SURVEY

The Contractor shall provide the COTR with copies of the Surveyor's field book recording the measurements of the installed locations, invert elevations, and the deviations from the construction drawings of manholes. The Surveyor shall also record his measurements on the as-built set of drawings and record the date of surveys.

3.13 ACCEPTANCE

Sections of the sewer found defective in material, alignment, grade, or joints shall be corrected at no additional cost to the Government before acceptance.

-- End of Section --

SECTION 02537

SANITARY METERING MANHOLE
01/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|-------------|---|
| ASTM D 638 | Standard Test Method for Tensile Properties |
| ASTM D 790 | Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| ASTM D 2583 | Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor |
| ASTM D 3753 | Standard Specification for Glass-Fiber Reinforced Polyester Manholes |

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

The Contractor shall submit for approval catalogs, and or/technical information on all major items of materials and equipment required completing the project in accordance with the contract documents.

SD-04 Drawings

The Contractor shall submit for approval installation drawings on all major items of materials and equipment required completing the project in accordance with the contract documents.

SD-04 Shop Drawings

Show critical dimensions, jointing and connections, fasteners and anchors; materials of construction; sizes, spacing, and location of structural members, connections, attachments, openings, and fasteners; and color(s).

SD-06 Instructions

Manufacturer's instructions for all products used shall be submitted, including any special instructions for equipment installation, for approval prior to use.

SD-13 Certificates

Test results of representative fiberglass reinforced plastic laminate.

1.3 DESCRIPTION OF WORK

Work of this Section includes, but is not limited to: installing a metering manhole; connecting a bubbler line to the metering manhole; and installing a concrete ballast/leveling slab.

1.4 DELIVERY, STORAGE, AND HANDLING

Contractor shall store products indoors or in weather-protected area until installation. Contractor shall protect products from traffic and damage. At all times, especially during the loading, unloading, and storage, the Contractor shall take care to ensure that the manhole is not dropped or otherwise damaged. The manhole should be stored on a smooth surface free of sharp objects. Nylon or fabric slings should be used in conjunction with a spreader bar to lift or move the manhole. UNDER NO CIRCUMSTANCES SHOULD CABLES OR CHAINS BE USED. If the manhole is stored horizontally, the manhole should be placed in such a way as to avoid damage to the flume, cover, and end adapters.

PART 2 PRODUCTS

2.1 METERING MANHOLE

The Contractor shall furnish and install a metering manhole. The product manufactured by TRACOM, Inc.; 6576-A Industrial Way, Alpharetta, Georgia 3004; Tel. (877) 433-8637, Fax (770) 664-6565, www.tracomfrp.co is acceptable. Fiberglass tanks modified for flume installation shall not be allowed. Manholes shall be warranted to be free of defects in workmanship and materials for a period of two years from shipment.

2.1.1 Manhole Dimensions

The manhole shall be 1.22 m in diameter by 1.975 m high. The walls shall have a minimum 1.22 cm wall thickness. Integrally molded inlet and outlet PVC or fiberglass pipe stubs of 305 mm diameter laminated to both the interior and exterior surfaces of the manhole.

2.1.2 Manhole Construction

The manhole shall be manufactured by fiberglass-reinforced plastic, complying with ASTM D 3753.81. The manhole shall be factory-assembled, ready for installation except for field-installed equipment. The exterior

surface shall be relatively smooth with no sharp projections. The surface shall be free of blisters larger than 1.27 cm in diameter, delamination and fiber show. The interior surfaces shall be resin rich with no exposed fibers. The interior surfaced shall be smooth for improved corrosion resistance and reduced sludge build-up. The surface shall be free of crazing, delamination, blisters larger than 1.27 cm in diameter, and wrinkles of 0.3175 cm or greater in depth. The manhole shall have integral fiberglass ladder bolted and glassed to the manhole wall with 5.08 cm by 5.08 cm pultruded fiberglass rungs with *photoluminescen* high visibility non-slip top surface and reinforced with threaded T-304 0.794 cm diameter stainless steel rods. The manhole shall have flexible PVC boots with stainless steel bands to connect 305 mm diameter manhole pipe stubs to 305 mm diameter vitrified clay pipe *(for use with pipe stubs* .

2.1.3 Bead Board

A 1.9 cm thick expanded polystyrene bead board shall be supplied to place under the manhole on the concrete slab.

2.1.4 Mounting Flange

A 10 cm integrally mounting flange shall be molded around the circumference of the manhole for anchoring to concrete.

2.1.5 Confined Space Entry Sign

An OSHA approved "Confined Space Entry" sign shall be applied to the interior surface of the manhole above the first ladder rung.

2.1.6 NPT Coupling

The manhole shall have one 5.08 cm NPT coupling to facilitate the installation of sample or bubble tubing, electrical power, or other cabling into the manhole.

2.1.7 Materials

The resins used shall be unsaturated, supplier certified, isophthalic polyester resins. Mixing lots of resin from different manufacturers, or "odd-lotting" of resins shall not be permitted. Quality assurance records on the resin shall be maintained. Non-pigmented resin is required to allow for light or "sand" color of manhole surface in order to facilitate easy from grade interior inspection. UV inhibitors shall be added directly to the resin to prevent photo degradation. A 15 mil isophthalic UV resistant gel coat shall be applied on all exterior surfaces. Reinforcing materials shall be commercial grade E-glass with a coupling agent that will provide a suitable bond between the glass reinforcement and the resin. The laminate shall consist of multiple layers of glass matting and resin. The surface exposed to the sewer/chemical environment shall be resin rich and shall have no exposed fibers.

| | |
|--------------------------------|-------------|
| Tensile strength (ASTM D 638) | 96.53 MPa. |
| Flexural strength (ASTM D 790) | 172.37 MPa. |
| Flexural modulus (ASTM D 790) | 6,895 MPa. |

Barcol hardness (ASTM D 2583) 40
 Stiffness (ASTM D 2412):

| <u>Manhole Length (m)</u> | <u>kPa</u> |
|---------------------------|------------|
| 0.8 - 1.83 | 34.198 |
| 2.13 - 3.66 | 59.915 |
| 3.96 - 6.10 | 95.837 |
| 6.40 - 7.62 | 143.411 |
| 7.92 - 10.67 | 248.901 |

2.1.8 Opening Dome Top

The metering manhole shall have: 1.22 m full diameter, fully opening dome top cover rated for 47.88 kPa static loading with stainless steel piano hinge, stainless steel lockable hasp, locking cover support bar, and soft neoprene sponge gasket for sealing with the following height:

The manhole shall be 1.975 m high, and

Dome top manholes: inlet invert to surface grade plus 30.48 cm (typical).

2.1.9 Flume Type

Trapezoidal type, Large 60 Degree V sized with integral inlet and outlet end adapters. The flume shall have the following (options):

5-mil mylar, laminated, high visibility staff gauge graduated in meters with 2 millimeter divisions, and

Removable T-304, 0.3175 cm O.D. stainless steel bubble tube.

PART 3 EXECUTION

3.1 EXAMINATION

The Contractor shall verify that the flume dimensions are correct and project conditions are suitable for installation. Contractor shall report any discrepancies to the COTR. Contractor shall not proceed with installation until condition deficiencies have been corrected.

3.2 INSTALLATION

Install products in accordance with contract plans and specifications, local codes, GRC Safety and Environmental Regulations, and in a manner consistent with the installation instruction and recommendation of the manufacturer. Ensure that the product is installed plumb and true, free of twist or warp, within the tolerances specified by the manufacturer and as indicated in the contract documents.

3.2.1 Lifting the Manhole

Nylon or fabric slings should be used in conjunction with a spreader bar to

lift or move the manhole. UNDER NO CONDITIONS SHOULD CHAINS OR CABLES BE USED.

3.2.2 Excavation

Excavate an area large enough to contain the manhole and the concrete pad while allowing for sufficient space to allow for a safe work environment. Follow all OSHA requirements for open trench construction.

3.2.3 Concrete Pad

Contractor shall place a 28.0 MPa concrete pad of sufficient width and length to support all of the manhole, the flume, and the connecting piping. The thickness of the pad shall be 280 cm and shall be sized to ensure that proper loading is observed and that the manhole will not float (1.83 m x 1.83 m). The surface of the pad shall be troweled and level to 0.32 cm. The Contractor shall clean the concrete slab of all sharp objects and debris before laying the foam pad provided with the manhole.

3.2.4 PVC Boots

If PVC boots are provided, the Contractor shall install them on the manhole pipe stubs before lowering the manhole into the opening.

3.2.5 Installation of Manhole

Contractor shall lower the manhole onto the pad. Afterwards, the Contractor shall drill holes in the foam and concrete pads to accept the stainless steel anchor bolts (*as supplied by the manhole manufacturer*). The Contractor shall check to ensure that the flume is level from side to side and from front to back, and adjust the pad and anchor bolts as necessary. The piping shall be connected and secured. The Contractor SHALL NOT LUBRICATE THE PVC BOOTS IF PROVIDED.

3.2.6 Grout

The Contractor shall grout under all sections of the manhole above the slab.

3.2.7 Backfill

The Contractor shall backfill with pea gravel, 0.635 cm to 1.905 cm in diameter, using uniform lifts of no more than 30 cm.

METERING MANHOLES ARE CLASSIFIED AS CONFINED SPACE ENTRY LOCATIONS. CONSULT ALL APPROPRIATE GRC, LOCAL, STATE, AND FEDERAL REGULATIONS BEFORE ENTERING. A GRC Confined Space Permit is required before entering a manhole.

3.3 ADJUST AND CLEAN

The Contractor shall clean surfaces in accordance with the manufacturer's instructions, remove trash and debris, and leave the site in a clean condition.

-- End of Section --

SECTION 02538

BUBBLER FLOW METER

01/02

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

The Contractor shall submit for approval catalogs, and/or technical information on all major items of materials and equipment required completing the project in accordance with the contract documents.

SD-04 Drawings

The Contractor shall submit for approval installation drawings on all major items of materials and equipment required completing the project in accordance with the contract documents.

SD-06 Instructions

Manufacturer's instructions for all products used shall be submitted, including any special instructions for equipment installation, for approval prior to use.

1.2 DESCRIPTION OF WORK

Work of this Section includes but is not limited to:

Providing a new outlet connection from existing power panel, P1018, in Building 20 through an underground 1.27 cm PVC conduit extending to a new NEMA 4 enclosure mounted on pipes embedded into a concrete pad. Provide for grounding and fusing of enclosure and circuitry.

Providing new termination for the existing 4 to 20 mA cable in Building 20 and install the new cable into a 1.27 cm PVC conduit extending from the interior of Building 20 to the NEMA 4 enclosure.

Providing a bracket to support the new bubbler meter into the new NEMA 4 enclosure.

Providing underground routing of a new bubbler line to a metering manhole.

Providing and installing a new bubbler flow meter, and setting and

calibrating the bubbler flow meter.

Related Sections include the following: Section 02537 "Metering Manhole."

PART 2 PRODUCTS

2.1 INSTRUMENT

Contractor shall furnish a recording, totalizing open channel flow meter suitable for portable or fixed-site monitoring. A bubbler system shall be used to measure level. The product manufactured by ISCO, Inc.; 4700 Superior Street, Lincoln, Nebraska 68504; Tel. (800) 228-4373, Fax (402) 465-3022, www.isco.co, is acceptable.

2.2 BUBBLER

2.2.1 Pressure Transducer

A pressure transducer in the flow meter shall measure the liquid level. An internal air compressor shall provide a continuous supply of air to the bubble tube. The bubble shall be 0.32 cm inside diameter and 15.2 m long. A stainless steel bubble tube shall be supplied for installation in the flow stream. The flow meter shall include automatic bubble line purge to minimizing plugging of the bubble tube.

2.2.2 Level Measurement Range

The level measurement range of the bubbler shall be from 0.003 to 3.05 m. The level shall be measured with a maximum error of ± 0.002 m over a range of 0.003 to 0.31 m, ± 0.003 m over a range of 0.003 to 1.52 m and ± 0.011 m from 0.003 to 3.05 m. The temperature coefficient shall be ± 0.00054 times the level in meters times the temperature change from 25 degrees C over the compensated temperature range of 0 to 60 degrees C.

2.2.3 Automatic Drift Compensation

The flow meter shall include automatic drift compensation to periodically reference both sides of the transducer to atmosphere pressure and automatically compensate for errors due to temperature, warm-up and long-term drift. After a 5-minute warm-up period, automatic drift compensation shall correct the zero level to ± 0.0006 m at intervals between 2 and 15 minutes.

2.3 FLOW METER

2.3.1 Internal Conversion Algorithms

Measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow meter shall contain conversions for V-notch weirs, rectangular weirs with and without end contractions, Cippolletti weirs, and Parshall, Palmer-Bowlus, Leopold-Langco, trapezoidal, H, HS, and HL flumes. For monitoring in applications using the Manning formula in round, U-shaped, rectangular and trapezoidal channels, the flow meter shall accept information for channel

shape and size, and slope and roughness coefficient. The flow meter shall accept 4 sets of level-flow rate points, with up to 50 pairs of points in each set. The flow meter shall accept a two-term, level-flow rate polynomial equation.

2.3.2 Tactile Keypad

The flow meter shall contain a tactile keypad and a 2 line, 80 character, backlit alphanumeric liquid crystal display (LCD). The LCD shall visually prompt the user through the programming sequence. The LCD shall display level, flow rate, total flow. The totalizer on the LCD shall be resettable. The flow meter shall include a non-resettable, mechanical totalizer. The LCD shall display the signal strength from the ultrasonic sensor to aid in installation and troubleshooting.

2.3.3 Dot Matrix Printer

The flow meter shall contain a dot matrix printer with a replaceable roll of plain white paper 11 cm wide and 19.8 m long, and a replaceable black nylon ribbon 6.0 m long. The printer shall record up to 3 graphs of level, flow rate, at user-selectable chart speeds ranging from 1.25 to 10 cm per hour. The recording span for each graph shall be user-selectable with multiple automatic over-ranges if the maximum scale is exceeded. The chart shall include total flow, time and date, site ID, flow conversion, and recording span for each graph. The printer shall provide 2 summary reports of minimum, maximum, average and total data over 2 independent time intervals. The printer shall provide a flow meter history report, including the time when the level, were adjusted, the totalizer was reset, or sampler was enabled. The printer shall print the flow meter program on command.

2.3.4 Internal Data Storage Memory

The internal data storage memory in the flow meter shall have a capacity of 473,000 bytes, divided into up to 12 user-defined partitions. Each partition shall be programmable to store level, and flow rate. Timing for the data storage shall be selectable in 1, 2, 5, 10, 15, 30, 60, or 120-minute intervals. Each partition shall be programmable to operate in either rollover, slate or triggered slate mode. Triggering events in slate mode shall be selectable from level, and flow rate. The internal data storage memory in the flow meter shall be programmed using a software program on an IBM PC or compatible computer. The software shall also retrieve stored data from the flow meter, and generate graphs and reports from stored data. The computer shall communicate with the flow meter using a direct RS-232 connection.

2.3.5 Analog Outputs

The flow meter shall include 2 internal isolated analog outputs. Each output shall be programmable to output level, and flow rate. The analog outputs shall be programmable to output 4 to 20 mA or 0 to 20 mA, and the outputs shall be averaged on a programmable time interval of 0, 15, 30, or 60 seconds. The flow meter shall allow the analog outputs to be manually controlled to test the operation of connected equipment. The flow meter

shall include an external 4 to 20 mA output interface. The interface shall be programmable to output level, flow rate.

2.3.6 C Relays

The flow meter shall have 2 form C relays with user-selectable trip points based on flow rate.

2.3.7 RS-232 Serial Output

The flow meter shall have a RS-232 serial output to transmit information on all of its current readings. The data on the serial output shall be in ASCII format with values separated by commas. The serial output shall be at 1200, 2400, 4800, or 9600 baud. The flow meter shall output this data in response to the reception of a command on the serial port. The flow meter shall also be programmable to automatically transmit this data on a periodic time interval. The data shall include the flow meter description, ID number, model number, date and time, battery voltage, level, flow rate, total flow, and check sum.

2.3.8 Program Memory

The program memory in the flow meter shall be non-volatile, programmable flash memory. The program memory shall be capable of being updated via the serial port on the flow meter without opening the enclosure.

2.3.9 Power

The flow meter shall require 12-volt DC power for operation. Power shall be supplied from a 120 VAC power converter with built-in backup battery. Typical battery life shall be 7 to 8 days with a 4 amp-hour nickel cadmium battery with the printer set a 2.5 cm per hour and a 1-minute level reading interval.

2.3.10 Enclosure

The flow meter shall be housed in a rugged, lockable, watertight, dust-tight, corrosion resistant (self-certified NEMA 4X and IP65) enclosure. The enclosure shall include a carrying strap, wall mounting bracket and a clear polycarbonate window for viewing the LCD and printer without opening the enclosure. An internal, easily replaceable, rechargeable desiccant canister shall keep the inside of the flow meter free of moisture.

2.4 EQUIPMENT PANEL ENCLOSURE

2.4.1 Enclosure

Electrical flow monitoring equipment and associated electrical/electronic appurtenances shall be mounted within a NEMA 4 stainless steel 60 cm x 60 cm enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with a lockable chrome plated handle having an interior captive closing hasp. Flow meter, 4 to 20 mA interface cabling with electrical junction boxes and electrical power feed and boxes shall be mounted on a

removable painted steel back panel secured to the enclosure with collar studs.

2.4.2 Mounting and Connections

All electrical components, instruments, and piping shall be mounted using treaded fasteners or din rail and shall be clearly labeled to indicate function. Conduit connections to enclosure shall meet or exceed current electrical code.

2.4.3 Enclosure Mounting

Enclosure shall be mounted upon two 6.35 cm diameter by 165 cm tall concrete filled galvanized pipes extending perpendicularly from a 90 cm x 90 cm x 15.24 cm thick level concrete pad set at grade. Vertical 6.35 cm diameter pipes shall be embedded in concrete a minimum of 91 cm below grade.

2.4.4 Grounding

The stainless steel equipment panel shall be properly grounded at the equipment panel location with an appropriately sized grounding rod of sufficient length meeting national and local electric codes and GRC requirements.

2.5 CONDUIT AND WIRING

2.5.1 Exterior Conduit

Underground and exterior conduit shall be type Rigid NM Conduit Schedule 40. Size to be provided is 1.27 cm.

2.5.2 Interior Conduit

The interior of Building 20 shall use type Rigid Metal UL listed conduit. Size required 1.27 cm.

2.5.3 Equipment Panel Conduit

The interior of the equipment panel enclosure shall have wiring installed in Rigid Electronic Galvanized Electrical UL listed conduit. Size required 1.27 cm.

2.5.4 Liquid Tight Connectors

The interior of the equipment panel enclosure shall have weatherproof boxes with liquid tight connectors for power and instrument control cabling.

2.5.5 GFCI Receptacle

Electrical service shall terminate at a grounded 20-amp commercial grade duplex GRCI receptacle.

2.5.6 Ground

Stranded wire for power from Building 20 to the equipment panel enclosure shall be size AWG 12 and THHN with two (2) #12 for power and one (1) #12 for ground from building.

2.5.7 Instrumentation Control Cable

A twisted 4 pair instrumentation control cable shall be installed from the abandoned flow monitor location in Building 20 and routed through a 1.27 cm, conduit terminating in the equipment panel enclosure. Cable shall match existing cable in size, type, and color-coding.

2.5.8 Expansion Joint Fittings

Any necessary expansion joint fittings shall be installed on the exterior conduit to provide for settlement of the back filled soil and freeze thaw.

2.5.9 Compliance to Codes

All electrical and electronic work shall be installed in compliance with national and local electric codes.

2.5.10 Pig Tail Connections

The flow meter supplier shall provide pigtail connections for the 4 to 20 mA interfaces to be used to connect the flow monitor to the waterproof junction box in the equipment panel enclosure where the instrument control cable is terminated. This pigtail shall be provided with waterproof connectors at both ends.

PART 3 EXECUTION

3.1 PREPARATION

The site shall be restored to original conditions, as acceptable to the COTR. The Contractor shall minimize disturbed areas during construction. The Contractor shall not interrupt existing utilities unless permitted by the COTR under the following conditions and then after arranging for temporary utility service. The Contractor shall request permission from the COTR not less than five working days in advance of proposed utility interruption.

3.2 CONSTRUCTION

3.2.1 Instrumentation Control Cabling

The contractor shall route power and instrumentation control cabling to the exterior of Building 20.

3.2.2 PVC Conduit

The Contractor shall run two underground 1.27 cm PVC conduits to the proposed equipment panel enclosure.

3.2.3 Equipment Panel

The Contractor shall set and equip the proposed equipment panel enclosure including the flow monitor and associated electrical power and data instrumentation control cabling connections.

3.2.4 Wiring

The Contractor shall run all necessary wiring for the electrical service and instrumentation for the flow-monitoring unit.

3.2.5 Bubbler Line Conduit

The Contractor shall install the bubbler line through a 1.27 cm PVC conduit to the new metering manhole.

3.3 FINAL ACCEPTANCE

3.3.1 Survey Underground Work

The Contractor shall notify the COTR when any underground installation is taking place so that the Government can survey and document the location of the underground work.

3.3.2 Inspection

The Government shall inspect all electrical work at the conclusion of the installation. The Contractor shall demonstrate to the Government that the flow meter and data acquisition system are operating properly.

3.3.3 Site Restoration

The Government shall inspect the site to determine that the site has been restored to original or better condition.

3.3.4 Operation Manuals

The Contractor shall provide six operational manuals of the flow meter to the COTR plus one current copy of ISCO Open Channel Flow Measurement Handbook.

3.3.5 Calibration, Warranty and Maintenance

The Contractor shall assure the Government that the flow monitor has been properly calibrated. The Contractor shall provide to the Government a warranty and maintenance agreement for the flow monitor covering a period of three years from initial start up.

3.3.6 Service Visits

The Contractor shall arrange and provide that a representative of the manufacturer provide a one-day calibration and operator training and an additional one-half day training sixty to ninety days after the initial training.

-- End of Section --

SECTION 02539

SANITARY SEWER RELINING
02/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|-------------|--|
| ASTM C 150 | (1995) Standard Specification for Portland Cement |
| ASTM C 443 | (1994) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets |
| ASTM C 564 | (1995) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings |
| ASTM D 1869 | (1994) Rubber Rings for Asbestos-Cement Pipe |
| ASTM D 3034 | (1994) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| ASTM F 1216 | (1993) Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube |

OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

| | |
|----------|---|
| ODOT 703 | (1997) Aggregate; and Subparts as Specified |
|----------|---|

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-04 Drawings

As-Built Drawings for the complete Sanitary Sewer System.

1.3 RECORD DRAWINGS

Upon completion of sewer construction, one set of prints shall be marked up and submitted for approval. Cover sheet shall include a list giving manufacturer's name, type and class for all pipe; manufacturer's name for manholes and the Contractor's name that installed the sanitary sewers. Dimensions shall be given showing distance between manholes and laterals for sewers. Any changes in elevation or alignment shall be changed from original. Dimensions and elevations shall be field verified by a Registered Professional Surveyor prior to submittal.

1.4 RECORD VIDEO TAPING

The Contractor shall video tape the inside of all the sewers subject to this project as follows:

Reline sewer runs shall be taped after cleaning, and after relining.

One copy of all tapes shall be submitted to the COTR within 3 working days after they are taken.

PART 2 PRODUCTS

2.1 SEWER RELINING

All sewers to be relined shall be cleaned prior to relining. In-situ sewer relining shall use the cured-in-place-pipe (CIPP) process using materials and methods as specified in ASTM F 1216, except that, as in alternate, the felt liner may be pulled in place rather than inverted. All other requirements shall be enforced.

Generally, this system shall involve the manufacture of a felt sleeve that is impregnated with a liquid resin. The sleeve shall be placed in the sewer pipe and expanded against the pipe walls. No annular space shall remain between the sleeve and the original pipe wall. An elevated temperature medium such as water or steam shall then be introduced within the sleeve for a period of time sufficient to cure the resin into a solid. Robotic equipment shall then traverse the pipe, restoring all lateral connections. Prior to placing the sleeve, point repairs shall be made to structurally deficient areas, protruding laterals shall be removed and the entire sewer cleaned of all adhered deposits and loose debris.

Following the CIPP installation, the hydraulic flow capacity of the lined pipe shall be at least equal to the previously existing nominal flow capacity of the sewer.

2.1.1 Structural Strength

The Contractor is responsible for designing the lining system to withstand a full hydrostatic load at depth.

A performance guarantee is required.

2.1.2 Sewer Pipe Repair

The sewer shall be repaired robotically from within the pipe; no point excavations shall be done. All materials, tools, and equipment shall be supplied by the Contractor. Protruding laterals consist of vitrified clay and cast iron.

2.1.3 Flow Diversion

Flow diversion piping shall be capable of being driven over by tractor-trailer rigs without damage.

2.1.4 Manhole Repairs

Existing manholes designated on the drawings shall be repaired (relined) by applying a monolithic fiber-reinforced structural/structurally enhanced cementitious liner to the wall and bench surfaces of brick, concrete or any other masonry construction material. Cementitious mix shall form a monolithic liner of a minimum 12 mm thickness, with machinery specifically designed for the application.

All aspects of the installations shall be in accordance with the manufacturer's recommendation and with the following specifications which includes:

1. The removal of any loose and unsound material.
2. Cleaning of the area to be sprayed with high pressure water.
3. The repair and filling of voids.
4. The repair and sealing of the invert and benches.
5. The spray application of a approved cementitious mix to form a structural/structurally enhanced monolithic liner.

Strong-Seal MS-2 and Spraymate 35D as used by Strong-Seal Systems Corporation, Post Office Box 8029, Pine Bluff, Arizona 71611 shall be an acceptable product.

2.2 CEMENT MORTAR

Mortar shall consist of 1 part portland cement and 2 parts fine sand with enough water to produce mortar of the proper consistency for the type of joint.

2.3 CONCRETE AGREGATES

Aggregates shall conform to ODOT 703 except that granulated slag (703.08) shall not be permitted.

2.4 RUBBER GASKETS

Rubber gaskets shall conform to ASTM C 443, ASTM C 564, and ASTM D 1869.

2.5 PIPE

Pipe shall be as follows:

Polyvinylchloride (PVC) pipe and fittings shall conform to ASTM D 3034, Cell Classification 12454-B.

2.6 PORTLAND CEMENT

Cement shall conform to ASTM C 150, Type I.

PART 3 EXECUTION

3.1 RELINING SEWERS

3.1.1 Design

Sewer inspection, record taping, CIPP system choice and design shall be done by the Contractor in compliance with ASTM F 1216 and this specification. All field investigations required to support design work are the responsibility of the Contractor. The design shall be submitted to the COTR for prior approval in accordance with Section 01330 and shall contain all calculations and descriptions of installation, curing, and repair procedures.

3.1.2 Flow Diversion

The Contractor is responsible for all flow diversion.

3.1.3 Laterals

All laterals that protrude more than 25 mm into the sewer shall be cut back to within 25 mm of the wall surface.

3.1.4 Sewer Cleaning

All sewer pipe and manholes to be relined shall be thoroughly cleaned. All hard deposits and roots shall be removed to within 12 mm of the pipe-wall surface. All loose debris shall be completely removed.

3.2 ACCEPTANCE

Sections of the sewer found defective in material or joints shall be corrected at no additional cost to the Government prior to acceptance.

-- End of Section --

SECTION 02635

STORM SEWER
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-103 (1988) Concrete Pipe Installation Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 74 (1994) Standard Specification for Cast Iron Soil Pipe and Fittings

ASTM A 746 (1994) Standard Specification for Ductile Iron Gravity Sewer Pipe

ASTM C 387 (1987) Standard Specification for Packaged, Dry Combined Materials for Mortar and Concrete

ASTM C 443M (1994) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)

ASTM C 76M (1995) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C 828 Low-Pressure Air Test of Vitrified Clay Pipe Lines

ASTM C 923M (1994) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

ASTM D 2321 (1989) Standard Practice for Sewers and Other Gravity-Flow Applications

ASTM D 3034 (1994) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM F 1417 (1992) Standard Test Method for Installation Acceptance of Plastic Gravity

Sewer Lines Using Low Pressure Air

ASTM F 794 (1991) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

AMERICAN WATERWORKS ASSOCIATION (AWWA)

AWWA C111 (1990) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT 499 (1997) Concrete General; and Subparts as Specified

ODOT 604 (1997) Manholes, Catch Basins, Inlets, Inspection Wells, Junction Chambers or Monuments; and Subparts as Specified

ODOT 605 (1997) Underdrains; and Subparts as Specified

ODOT 706 (1997) Concrete and Clay Pipe; and Subparts as Specified

ODOT 707 (1997) Steel, Aluminum and Plastic Pipe; and Subparts as Specified

ODOT 711 (1997) Structural Steel and Structure Incidentals; and Subparts as Specified

ODOT 712 (1997) Miscellaneous, and Subparts as Specified

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Mix Designs for Concrete shall be submitted.

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following:

Pipe
Grout

Mortar
Gaskets
Compression Joints
Manhole Frames/Covers
Grating and Frames
Precast Concrete Manholes
Precast Concrete Base Slabs
Concrete Block
Sewer Brick
Bituminous Coating
Cold Bituminous Mastic Sealer

SD-04 Drawings

Contractor shall submit Coordination Drawings interferences for construction. Details of catch basins and manholes shall be shown with proper elevations.

SD-08 Statements

A Sewer Bypass Plan shall be submitted when sewer flow is to be interrupted. The following items shall be noted in the plan:

Proposed Schedules
Methods
Materials
Equipment

SD-09 Reports

Test Reports shall be submitted for the following items in accordance with the applicable paragraphs of this section:

Swelling Test
Infiltration Test
Exfiltration Test
Hydrostatic Test
Pneumatic Plug Test

SD-13 Certificates

Certificates of Compliance for the following items shall be submitted in accordance with the applicable paragraphs of this section for:

Pipe
Grout
Mortar
Gaskets
Compression Joints
Manhole Frames/Covers
Grating and Frames
Precast Concrete Manholes
Precast Concrete Base Slabs

Concrete Block
Sewer Brick
Bituminous Coating
Cold Bituminous Mastic Sealer

1.3 BEDDING

Bedding shall conform to the contract drawings and Section 02225, "Excavation, Backfilling, and Compacting for Utilities."

PART 2 PRODUCTS

2.1 UNDERDRAIN MATERIAL

2.1.1 PVC Underdrains

Underdrains shall be in accordance with ODOT 707.41, perforated per ODOT 707.36. All elbows shall be long sweep.

2.2 FILTER MATERIAL

2.2.1 Filter Fabric

Fabric shall be in accordance with ODOT 712.09, Type A Geotextile Fabric for Underdrains.

2.2.2 Filter Aggregate

Aggregate shall be in accordance with ODOT 605.03(c), No. 8 Limestone.

2.3 MANHOLE FRAMES, COVERS, AND GRATINGS

Frame and cover shall be of heavy design (215 kilograms minimum total weight) when the manhole is placed within the limits of the pavement or shoulder, otherwise the light design (125 kilograms minimum) may be used. Bearing areas shall be finished smooth and fitted so as to provide a firm and even seat for all portions of the over in the frame. Each cover shall seat in its frame without rocking and shall be marked as a matched frame and cover before delivery to the project. The following legend shall be cast in every cover: "STORM". The base of the frame shall be set in a full bed of Portland cement mortar, and so adjusted to conform to the finished pavement or shoulder elevation and slope. Castings shall meet the requirements of ODOT 604 and material shall conform to ODOT 711.13, Ductile Iron Castings.

2.4 CONDUIT PIPING, JOINTS, AND FITTINGS

2.4.1 Reinforced Concrete Pipe (RCP)

Round RCP shall conform to ASTM C 76M, be of Class 3, with wall type and with wire fabric reinforcement and Bell and spigot ends. Acceptability shall be in accordance with ASTM A 746.

2.4.2 Polyvinyl Chloride Pipe (PVC)

Type PSM Polyvinyl Chloride (PVC) Pipe shall be in accordance with ASTM D 3034, SDR 35, up to DN375 diameter. Pipe ends made for joints shall be elastomeric gasket type. PSM PVC Pipe, 450 to 1200 millimeter diameter shall be in accordance with ASTM F 794.

2.4.3 High Density Polyethylene Pipe (HDPE)

Pipe and fitting material shall be high density polyethylene meeting ASTM D3350 minimum cell classification 335420C; or ASTM D1248 Type III, Class C, Category 4, Grade P33.

Pipe shall have a smooth interior and annular exterior corrugations.

1. 12- to 36-inch (300 to 900 mm) shall meet AASHTO M294, Type S.
2. 42- and 48-inch (1050 and 1200 mm) shall meet AASHTO MP6-95.
3. 54- and 60-inch (1350 and 1500 mm) diameters shall have minimum pipe stiffness of 16 and 14 pii (110 and 97 N/M/mm), respectively, and shall meet all other requirements of AASHTO M294.
4. Manning's "n" value for use in design shall not exceed 0.010.

HDPE Pipe Joint :

Pipe shall be joined with the Sure-Lok (bell-and-spigot) joint meeting AASHTO M294 or AASHTO MP6-95. The bell-and-spigot shall incorporate a gasket making it silt-tight. Gaskets shall be installed by the pipe manufacturer.

Pipe Fitting :

Fittings shall conform to AASHTO M294 or AASHTO MP6-95. Fabricated fittings shall be welded on the interior and exterior at all junctions.

2.4.4 Cast-Iron Soil Pipe (CISP) and Fittings

Pipe and fittings shall be in accordance with ASTM A 74, service weight, with bell and spigot ends. Joints shall be in accordance with AWWA C111 push-on type.

2.5 PRECAST CONCRETE MANHOLES

Concrete manholes, risers, base sections, and tops shall be pre-cast and conform to ODOT 706.13.

2.5.1 Manhole Gaskets

Gaskets shall be in accordance with ASTM C 443M for joints between manhole sections.

2.5.2 Manhole Connectors

Connectors shall be in accordance with ASTM C 923M for joints between manhole and pipes.

2.6 MANHOLE AND CATCH-BASIN ACCESS STEPS

Access shall be in accordance with ODOT 711.31, using steps for manholes or catch basins at least 1200 millimeter deep.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

Excavation, backfill, and removal of unsatisfactory materials shall be in accordance with Section 02225, "Excavation, Backfilling, and Compacting for Utilities." and 02311, "Excavating, Backfilling, and Compacting for Structures."

3.2 GRADING

Grading shall be performed in accordance with Section 02225, "Excavation, Backfilling, and Compacting for Utilities."

3.3 PIPE INSTALLATION

3.3.1 Pipe Installation

Excavations shall be trimmed to required elevations. Objects which impair backfilling or compaction shall be removed. Over excavation shall be corrected with fill material of fine aggregate.

Pipe and fitting shall be inspected for defects before installing. Defective materials shall be removed from site.

Pipe interior shall be cleaned before installation. Pipe ends shall be sealed when work is not in progress.

Pipe shall be laid to line and grade, with bell end upstream.

Maximum variation from true slope shall not exceed 3.2 millimeter in 3048 millimeter.

Maximum deviation from design elevation shall not exceed 12.2 millimeter at any point in the system.

Maximum deviation from true line shall not exceed 6.1 millimeter for pipe 375 in diameter and smaller, 12.2 millimeter for pipe larger than DN375 in diameter.

Corrections shall be made at a rate not to exceed 30.5 millimeter for one length of conduit.

3.3.2 Reinforced Concrete Pipe Installation

Reinforced concrete pipe and fittings shall be installed in accordance with manufacturer's instructions, and ACPA 01-103.

3.3.3 PVC and HDPE Plastic Pipe Installation

Pipe and fittings shall be installed in accordance with manufacturer's instructions and in accordance with ASTM D 2321.

3.4 PIPE BEDDING

3.4.1 Bedding

Minimum compacted bedding under installed pipe shall be as per contract drawings, and in no case less than 100 millimeter.

Bedding shall be placed in layers not exceeding 150 millimeter in depth and compact. Additional layers shall be added until a minimum elevation of 300 millimeter above the pipe is achieved.

3.4.2 Compaction

Puddling or jetting shall not be permitted when compacting bedding materials.

3.5 JACKING PIPE

Jacking pipe shall not be used.

3.6 UNDERGROUND STRUCTURES

3.6.1 Structures

ASTM C 387, Type M mortar, 13 millimeter thick, shall be applied to both interior and exterior surfaces.

Top of manhole and catch basin covers shall be set flush with finished pavement surfaces. Elsewhere, tops shall be set 75 millimeter above finished surface.

Steps shall be attached into manhole walls with epoxy compound.

Preformed bituminous expansion-joint material shall be provided 19 millimeter thickness around drainage structures in PC concrete pavements and walks.

Joints for concrete risers and tops shall be made with flexible watertight rubber-type gaskets.

Catch basins and curb drop inlets shall be precast.

3.6.2 Concrete Construction

Concrete shall be in accordance with ODOT 499.

3.7 FIELD QUALITY CONTROL

3.7.1 Tests

Contractor shall provide test equipment or engage the services of a firm to provide the necessary testing.

3.7.1.1 Low Pressure Air Test of Conduit

Acceptance tests for installed ferrous and plastic piping shall be in accordance with ASTM F 1417.

Low Pressure Air Test

1. The Contractor shall perform an air test on sewers.
2. Approval of COTR is required.
3. Air Test procedure:
 - a. Plug all pipe outlets with suitable test plugs in section to be tested.
 - b. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 0.28 kilogram per square centimeter.
 - c. After an internal air pressure of 0.28 kilogram per square centimeter is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
 - d. After the two minute period, disconnect the air supply.
 - e. When pressure decreases to 0.25 kilogram per square centimeter, start timing with a stop watch.
 - f. Determine the time in seconds that is required for the internal air pressure to reach 0.18 kilogram per square centimeter.
 - g. Minimum permissible pressure holding times shall be as prescribed in ASTM C 828, Low-Pressure Air Test of Vitrified Clay Pipe Lines; in ASTM F 1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air; or as recommended by the manufacturer for the type of piping materials being tested.
4. All air tests shall be conducted with the utmost safety precautions, including but not limited to:
 - a. Bracing all plugs securely.
 - b. Not allowing personnel in manholes during testing.
 - c. Installing a pressure-relief system operative at 0.7 kilogram per square centimeter.

Deflection Test

1. A deflection test shall be made by pulling through the sewer a rigid ball or mandril having a diameter equal to 95% of the inside diameter of the pipe.
2. Deflection tests shall be performed no sooner than 60 days following completion of backfill.
3. All plastic pipe shall be tested for deflection.
4. Maximum ring deflection of pipe when backfilled shall be equal to or less than 5 percent of average inside diameter.
5. A copy of diameter record shall be submitted to the Engineer.
6. Any pipe showing deflections in excess of 5%, sixty (60) days after installation, shall be replaced at no cost to the Owner.

3.7.2 Interior Inspection of Pipe

Installed pipe shall be inspected when 600 millimeter of earth cover is in place and upon completion of project. Displaced or misaligned pipe, infiltration, accumulation of debris, or other defects shall be corrected by the Contractor at no additional cost to the Government.

3.8 ACCEPTANCE

Sections of the sewer found defective in material, alignment, grade, or joints shall be corrected at no additional cost to the Government before acceptance.

-- End of Section --

SECTION 02700

OIL/WATER SEPARATORS

11/00

PART 1 GENERAL

1.1 SUMMARY

The Contractor shall furnish the labor, materials, equipment, appliances, services and hauling, and perform operations in connection with the construction and installation of work. Work shall be as herein specified and as denoted on the drawings, but not limited to the following general terms of work:

Storm Sewer
Sanitary Sewer
Oil/Water Separator

Provide and install double-wall reinforced fiberglass oil/water separator tanks, hold-down straps and anchoring system, hydrostatic leak detection system for tanks, monitoring equipment, electrical panels, circuit breakers, conduit and wiring, turbine enclosures, manway extensions, piping and venting for the influent and effluent, and vent piping and caps for tanks required to make a complete installation ready for use. Furnish and install precast concrete trash interceptors and all necessary drainage and vent pipe and fittings. At one installation, Contractor shall install one gate valve between the trash interceptor and tank inlet, as well as one gate valve between the tank and the effluent pipe per drawings.

1.2 REFERENCES

ENVIRONMENTAL PROTECTION AGENCY (EPA)

| | |
|-----------|--|
| EPA 413.1 | Test Method: Oil and Grease, Total Recoverable (Gravimetric, Separatory Funnel Extraction) |
| EPA 413.2 | Test Method: Oil and Grease, Total Recoverable (Spectrophotometric, Infrared) |

1.3 SUBMITTALS

1.3.1 Test Results

The Contractor shall obtain from the manufacturer and provide calculations verifying that the oil/water separator is capable of producing effluent with no more than 10 ppm or 15 ppm, as per plan, free oil and grease (not dissolved nor chemically emulsified with soaps and detergents) when tested using the Coast Guard Method 46 CFR 162.50. The test inlet oils include both 0.8 and 0.95 specific gravity (approximate) oils.

For both oils, the testing and report will show results for:

Pre-lading the test vessel with each oil prior to starting the performance testing for that specific oil. These tests pre-coat the oil separating media. Pre-coating insures that claimed long term performance results are obtained in the performance tests and that dilution or absorption does not give false results.

The maximum claimed flow rate for the maximum claimed inlet oil concentration that results in 10 ppm oil discharge.

The maximum claimed flow rate for a lower than maximum claimed inlet oil concentration that results in 10 ppm oil discharge.

The maximum claimed flow rate for the maximum claimed inlet oil concentration that results in 15 ppm oil discharge.

A test for clean water contamination by analyzing effluent at the high and low flow rates tested, with no oil in the inlet water. Effluent cannot exceed 10 ppm or 15 ppm for the respective design previously tested.

Each test will be conducted for a minimum 3 vessel volumetric turnovers to show steady-state effluent conditions. Effluent samples will be obtained and analyzed after three (3) or more turnovers. During the entire test, oil is continuously fed and mixed with the inlet water. One vessel volumetric turn-over (time period in minutes) equals the entire vessel volume (gallons) divided by the flow rate (gallons/minutes).

An independent laboratory using test methods EPA 413.1 and EPA 413.2 shall analyze the oil/water effluent. A certificate of analysis shall be supplied for each analysis performed. The laboratory must be accepted under the EPA Contract Laboratory Program (CLP) and must also regularly analyze EPA check (audit) samples as required for the performance of NPDES permit analysis. This documentation must be supplied to the OWS manufacturer along with the certificates of effluent analysis and oils specific gravity and viscosity analyses for inclusion in the test report.

1.3.2 Shop Drawings

Contractor shall submit six (6) copies of shop drawings for each OWS tank. Drawings shall include all critical dimensions, location of fittings and accessories, i.e., manways, hold-down straps, secondary containment collar, manway extensions, turbine enclosures, etc.

1.3.3 Catalog Cut Sheets

Contractor shall submit six (6) copies of OWS manufacturer's literature.

1.3.4 CSI Installation, Start Up, Operations and Maintenance Manuals

The Contractor shall provide six (6) copies of Containment Solution Publications No. OWS 2012, and OWS 2013, which are the OWS installation,

start up operations, and requirements manuals.

1.3.5 UST Installer's Certification

Contractor shall submit six (6) copies of the current certification from the State of Ohio for the UST Installer.

1.3.6 Site Specific Safety Plan

The Contractor shall coordinate with NASA to provide a written site-specific health and safety plan (HASP). Before proceeding with any work, this document must be approved by the NASA Environmental Management Office (EMO) and the Glenn Safety Office (GSO). The Contractor shall use the NASA site-specific HASP template (format). Six (6) copies shall be submitted to the COTR for NASA approval.

1.3.7 Permits, Tests, Inspections

The Contractor shall obtain and pay for all permits, tests, inspections, etc. required by the state, regional and municipal governmental agencies, which have jurisdiction over the project. Original copies shall be submitted to the COTR.

1.3.8 UL Label

Oil/Water separator tanks shall be double-wall fiberglass, UL labeled, constructed to meet governing standards with certification plate (UL Label) affixed.

1.3.9 Calculations

The Contractor shall obtain from the tank manufacturer, calculations verifying oil/water separator suitability for depths shown on the drawings. Calculations must meet or exceed to loading conditions, depth of burial per plan, with excavated hole fully flooded and with a safety factor of 5 to 1 against general buckling.

1.3.10 Installation Checklist

The installation contractor shall provide a copy of the installation checklist to the COTR to validate any future warranty claims.

1.3.11 Completed Installation Checklist

Contractor shall submit six (6) copies of the completed Fluid Containment Inc. installation checklist certified by the installer that the installation was performed in full accord with the manufacturer's requirements.

1.3.12 Proof of Education

Contractor shall submit six (6) documents proving Fluid Containment Inc. educated the Contractor in the proper installation of fiberglass reinforced plastic underground storage tanks.

1.3.13 Leak Detection Test Results

The leak detection performance is to be documented on an EPA generated form called "Results of U.S. EPA Standard Evaluation -- Volumetric Tank Tightness Testing Method." The Contractor shall provide six (6) copies of the form to the COTR.

1.3.14 Trash Interceptor Shop Drawings

Contractor shall provide six (6) copies of shop drawings for the precast trash interceptors.

1.3.15 Pea Gravel Sieve Analysis

Contractor shall provide to the COTR a sieve analysis for the pea gravel tank backfill. The pea gravel must conform to ASTM C33 (naturally rounded aggregate free flowing).

1.3.16 Certification

The Contractor shall submit a certification from the manufacturer with each shipment of fabric material stating that it meets specification requirements.

PART 2 PRODUCTS

2.1 OIL/WATER SEPARATOR TANKS

Contractor shall provide double wall fiberglass reinforced plastic underground oil/water separator (OWS) tanks with fittings and accessories as denoted on the drawings. OWS tanks shall meet or exceed the following design criteria.

2.1.1 Loading Conditions

External Hydrostatic Pressure: Following manufacturer's requirements for the burial depths required, the buried tank shall withstand the pressure from overburden over the top of the tank as per drawings and have a safety factor of 5:1 against general buckling with the excavated hole fully flooded.

Surface Loads: The tank shall withstand a surface loading of H-20 axle loads (14,515 kg/axle) when installed according to manufacturer's installation instructions.

Internal Load: The tank shall withstand 3,515 kg/sq. meter (5 psi) air pressure test with a 5:1 safety factor. A leakage test shall be performed in accordance with Ohio Department of Commerce, Division of State Fire Marshal, Bureau of Underground Storage Tank Regulations (BUSTR) prior to installation.

Accessory Equipment Loads: Tank shall be designed to support accessory equipment as denoted on plans.

Tank must be separately vented at the influent tee, oil water separator chamber and at the effluent tee.

2.1.2 Capability

Tank shall be:

Capable of storing liquids with specific gravity of up to 1.1;

Capable of storing grease and oils at temperatures not to exceed 65.6 degrees Celsius at the tank interior face; and be

Chemically inert to petroleum products.

2.1.3 Warranty

The oil/water separator (OWS) shall be warranted for a period of (30) years from date of original delivery due to structural failure. Contractor shall insure the warranty by:

Strict adherence to the manufacturer's installation procedures;

Complete a Fluid Containment Inc. installation checklist; and

Being educated in the use of fiberglass tank installation through the use of Fluid Containment educational materials.

2.1.4 Coalescer Plates

Coalescer plates and associated internal mounting hardware shall be constructed of rustproof material and be removable through the 0.56 meter by 0.75 meter oval access manway. Areas above and below the coalescer plates must be sealed off to prevent oil/water mixture from flowing around the coalescer packs.

2.1.5 Anchor Straps

Contractor shall provide from the tank manufacturer fiber-reinforced plastic anchor straps for each tank on the drawings. The number and locations of straps shall be as specified by the manufacturer. Each strap shall be capable of withstanding the buoyancy load for tank diameter as indicated:

| | |
|---------------------|------------------|
| 1.22 meter diameter | 1,905 kilograms |
| 1.83 meter diameter | 8,165 kilograms |
| 2.44 meter diameter | 11,340 kilograms |
| 3.10 meter diameter | 14,515 kilograms |

2.1.6 Threaded Fittings

Threaded fittings on UL labeled tank shall be of a material of construction consistent with the requirements of the UL label. Fittings shall be supplied with cast iron plugs. Standard threaded fittings are 102 mm

diameter and shall be half couplings. Reducers are to be used for smaller sizes where specified and shall be provided by Contractor. Refer to drawings for size and location fittings.

2.1.7 Tank Laminate

The tank laminate shall consist of granular inert material with less than 1 percent moisture content.

2.1.8 Capability and Dimensional Requirements

Double-Wall Tanks

Oil/water separator tanks shall be double-wall fiberglass, UL labeled, constructed to meet governing standards with certification plate (UL label) affixed.

The following shall be as per drawings:

- Nominal volume of the separator tank.
- Total spill capacity.
- Total oil storage capacity.
- Inlet flow rate in liters per minute (LPM) shall be from zero(0) LPM to rate shown.
- Inlet and outlet flange diameter.
- Effluent flange diameter.
- Nominal overall length and diameter of the tank.
- Nominal outside diameter of the separator.

Oil/water separator shall perform for:

- All combinations of non-emulsified oil/water mixtures.
- Operating temperature range of the influent oil/water mixture from 4.5 degrees C to 65.6 degrees C.

2.1.9 Access Manway

Tank manufacturer shall provide on 559 mm by 734 mm oval or access manway with each tank. Tanks greater than 11,356 liter total capacity shall also be provided with a 559 mm flanged manway. all manways shall be furnished complete with UL listed gaskets, bolts and covers. Each manway cover shall include a 102 mm NPT steel fitting with lift lug plug.

2.2 TURBINE ENCLOSURES AND MANWAY EXTENSIONS

Contractor shall provide fiberglass reinforced plastic secondary containment collar and turbine enclosure as shown on the drawings. Manway extensions shall also be provided. The secondary containment collar shall be 1,067 mm diameter for containment around the 559 mm by 734 mm oval manway on the tank. The height for the turbine enclosure shall be per the drawings. The turbine enclosure top and lid assembly shall be sealed watertight and waterproof.

The installing contractor shall not use grommets for piping or electrical

connections. The contractor shall furnish two adhesive kits for every sealed enclosure supplied. Manway extensions are shown on the drawings, the Contractor shall furnish the correct diameter to mate with the specified manway diameter.

2.3 OIL/WATER SEPARATOR CONTROL SYSTEM

The Contractor shall provide from the tank manufacturer an electronic control panel constructed of UL listed, electronic components. The control panel power source is 12 volts AC. Contractor shall provide all wiring, conduits, and circuit breakers. The sensor monitoring circuit must be an intrinsically safe circuit; i.e., the circuit must be incapable of releasing sufficient electrical or thermal energy to cause ignition of specific hazardous material under "normal" or "fault" operating conditions.

The model number shall be Containment Solution Inc., Model CPF4. Four monitoring circuits shall be provided:

- Oil Level Warning
- Oil Pump-Out Alarm
- Interstitial Alarm
- Sludge Alarm

Each circuit shall have dry contacts for remote notification interface. The electrical components rating shall be weatherproof (NEMA 4). The dimensions of the control unit shall be 292 mm by 203 mm by 114 mm deep. The total power consumption shall be 0.1 amps and 120 VAC. The monitoring circuit power shall be 12 volts DC and 15 ma.

The model FHRB810 sensor and model FOWS interface alarm sensor shall be connected at the model CPF-4 control panel.

All control panels shall include:

- Alarm lights for each circuit
- Warning horn
- Auxiliary dry contacts which output for each sensing circuit
- Panel housing material shall be epoxy-coated steel
- Two spare light bulbs
- Alarm horn silence switch
- Shall not require shielded cable
- Sensor cable shall be #18 AWG up to 1,524 meters

The Contractor shall provide all wiring materials. Wiring is required from the power source to the control panel and from the control panel to the probe assembly.

2.4 OIL/WATER INTERFACE FLOAT SENSOR

The contractor shall provide an oil/water interface alarm sensor that is used to determine two separate high waste oil levels in the separator. One level is for the visual alarm. The second level is for visual and audible alarm. The level sensor shall float in water and sink in oil to determine the oil/water interface.

2.4.1 Oil/Water Interface Sensor

The oil/water interface sensor is to be Containment Solutions Inc. model FOWS 50U-B.

The Contractor is responsible for adherence to Containment Solutions Inc. oil/water installation instruction for lengths other than 610 mm length of riser pipe because the standard unit is a 610 mm length of riser pipe.

2.4.2 Oil Level Warning Alarm

The oil level warning alarm must activate as the top float approaches the bottom of its travel. This alarm must warn that the OWS tank is almost full of oil, and the oil will need to be removed soon.

2.4.3 Oil Pump Out Alarm

This alarm must activate as the bottom float approaches the stem bottom. The pump out alarm alerts the operator that the oil must be removed immediately to maintain efficiency of the oil/water separator.

2.5 TANKS LEAK DETECTION SYSTEM AND RESERVOIR SENSOR

Tanks shall provide an interstitial space between the primary and secondary tank walls to allow for free flow of brine monitoring liquid between tank's walls and containment of any released product from the primary tank.

2.5.1 Precision Tank Testing

The Contractor shall make provisions with the tank manufacturer to provide an inner and outer wall tank precision test within the first year following original shipment. Tank manufacturer's employees shall perform this test. The manufacturer shall provide copies of the precision tank test checklist to the Contractor and to the Government COTR.

The hydrostatic tank leak detection system shall be capable of detecting a breach in the inner and/or outer tank under the following installed conditions:

When the inner tank is empty.

When the inner tank is partially or completely full and the ground water table is below the tank bottom.

When the inner tank is partially or completely full and the tank is partially or completely submerged in ground water.

The leak detection performance of the monitoring system shall be tested and verified by a qualified independent consultant to detect leaks as small as 0.19 liters per hour with a 99.9 percent probability of detection and 1.2 percent probability of false alarm. The leak detection performance is to be documented on an EPA generated form called "Results of U.S. EPA Standard

Evaluation -- Volumetric Tank Tightness Testing Method."

The hydrostatic monitoring fluid shall be a nontoxic brine solution and shall be shipped in the interstitial space from the manufacturing plant. The brine shall be dyed a deep green color so as to aid Contractor in identifying damage to tanks. The tanks laminate shall be U.L. listed for compatibility with monitoring fluid.

The hydrostatic reservoir sensor shall include conductance probes made of titanium to determine monitoring fluid levels in the tank-mounted reservoir. The sensor shall be Containment Solutions Inc. model FHRB 810. Each tank shall have one FHRB 810.

2.6 CONCRETE TRASH INTERCEPTOR

Contractor shall furnish and install precast trash interceptors. Trash interceptors shall meet the requirements of sanitary sewer manholes.

2.7 SLUDGE SENSOR

Contractor shall provide level detection of liquid slurry medium at preset level of slurry/sludge accumulation of the oil/water separator. The sludge sensor shall be factory-installed model SSM 1F Sludge Sensor and shall be compatible with CPF control panels. The Contractor shall install a sludge sensor/control panel interface model 2PM2 with the CPF-4 panel.

2.8 GATE VALVES

The Contractor shall furnish gate valves with stem extensions. Valves shall be located between the trash interceptor and the tank inlet, and another located downstream of the effluent tee.

The gate valves shall be capable of 100 percent opening during normal operation to prevent flow turbulence.

The Contractor shall provide access to the 51 mm square-operating nut of the gate valve with 203 mm diameter ductile iron pipe. The pipe should overlap the containment manhole skirt to prevent pea gravel intrusion.

Contractor shall provide to the COTR two (2) valve key operating wrenches clearly tagged for each oil/water separator equipped with gate valves.

2.9 INLET AND OUTLET TEES AND PIPING

The Contractor shall provide ductile iron inlet and outlet tees for the separator system.

2.9.1 Tees

The flanges shall be ANSI class 125/150 flanges. The tees shall have 51 mm tapped blind flanges on the top of them to provide venting as shown on the drawings.

2.9.2 Inlet and Outlet Piping

Inlet and outlet piping to and from the OWS tank must be greater than or equal to the tank inlet and outlet nozzle diameter. If the inlet and outlet piping is greater than 152 mm diameter, install appropriate expansion joints of loops on any inlet and outlet tee/elbow connections. Both the inlet and outlet piping tees/elbows shall be vented to the atmosphere.

2.9.3 Sampling Port

The Contractor shall install a sampling port by installing a 51 mm tee on the effluent pipe and surrounding this with a 203 mm PVC, SDR 35, pipe and capping it.

2.10 FILTER FABRIC

The Contractor shall provide and install a Geotextile fabric in the tank excavation on all sides and on the top and bottom of the tank excavation. The purpose of the fabric is to maintain the separation of pea gravel and the sounding soil. The following products are acceptable filter fabric: Amoco CEF 4545 (Amoco Fabrics and Filters), TREVIRA S1125 (Hoechst Celanese Corporation), and TYPAR 3401 and TYPAR 3341 (Reemay, Inc.). The fabric shall be composed of strong rot-proof polymeric fibers formed into a woven or non-woven fabric. Polyethylene shall not be used as the filler fabric.

2.11 ACCESS WAYS

Contractor shall provide access ways as needed.

2.11.1 Gate Valves Access

Two 203 mm round access ways, Universal model 60-8075 or equal, are required for each separator.

2.11.2 Oil Draw Off Access

Industry standard spill containment manhole such as Emco Wheaton A1003-009 or OPW 4580 or equal.

2.11.3 Oil/Water Interface Sensor Access

The access shall be a 457 mm round manhole with screws and gaskets. The access must be offset to allow maximum clearance between oil draw off access and the interface sensor access. Universal 98-1810 or equal is acceptable.

2.11.4 Access Manhole

Access Manhole for 559 mm manway with 1.067 mm containment collar shall be a 914 mm by 254 mm round manhole. A Universal 58-3610 or equal is required.

2.11.5 Access Manhole for Coalescer Removal

A Safe-lite composite manhole, EBW 781-443 or equal shall be provided with

the dimensions of the turbine enclosure according to the drawings.

2.11.6 Effluent/Influent Sample Manhole

A 200 mm monitoring well access way with a clearly marked cast iron cover with a monitoring well designation shall be a Universal model 65-8012-WC or equal.

2.12 VENT CAP AND PIPING

Provide vent material according to the schedule below. Contractor shall use 51 mm FRP single wall piping.

2.12.1 Vent Cap

Vent cap shall be a 51 mm aluminum upward "v" vent cap such as OPW 23 or equal.

2.12.2 Vents

The OWS tank inlet, outlet, and the tank itself must be vent separately to the atmosphere to ensure proper operation of the OWS tank. All vents must be separate. Manifolding of vent pipes is not permitted.

2.13 OIL DRAW OFF BY VAC TRUCK

Contractor shall provide the following materials for the oil draw off. Details are shown on the drawings.

Manholes per the subsection on the on access ways.

20 Emco Wheaton 4x2 double tapped bushing or equal.

200-F-AL Andrews 51 mm Cam and Grove adapter and Male NPT or equal.

200-DC-AL Andrews 51 mm Cam and Grove Dust Cap.

Fifty-one millimeter suction pipe with length determined by the burial depth.

2.14 INTERSTITIAL SENSORS

Contractor shall provide a monitoring system to monitor the annular space of the double-wall oil/water separator tank. The sensors interface with CPF control panels furnished by the tank manufacturer Containment Solution Inc.

PART 3 EXECUTION

3.1 INSTALLATION OF OIL/WATER SEPARATORS

3.1.1 Qualified Personnel

Contractor's personnel involved with tank system installation shall be

educated by tank system manufacturer and the State of Ohio governing agency or agencies, for example, BUSTR and OEPA.

3.1.2 Test

Contractor shall test and install tank according to current installation instructions provided by the tank manufacturer.

3.1.3 Unloading Tanks

The double wall tanks shall be unloaded from the truck in accordance with the manufacturer's instructions. Upon delivery, the Contractor shall inspect the OWS tank for exterior damage. The manway cover plates shall be removed and the interior of the tank inspected to insure that all baffles, coalescer packs and internal piping are secure and have not been damaged.

3.1.4 Installation

All tanks and piping shall be installed in accordance with the manufacturer's instructions and either "Petroleum Equipment Institute Publication RP 100-90; Recommended Practices for Installation of Underground Liquid Storage System" or "American Petroleum Institute Publication 1615-87; Installation of Underground Petroleum Storage systems."

Tanks shall be tested and installed according to the current installation instruction provided by the tank manufacturer. Containment Solutions Publication #3-PE-18151 is considered a part of these specifications.

3.1.5 Permits

The Contractor's Installation of the OWS shall comply with the requirements of the State of Ohio, State Fire Marshal's Office, Bureau of Underground Storage Tank Regulations (BUSTR) for the installation of the OWS. The Contractor shall have the responsibility of notifying and coordinating with all local and state officials, including NASA, Ohio Environmental Protection Agency (Ohio EPA), State Fire Marshal, and the City of Cleveland Fire Department. The Contractor shall pay all inspection, sampling and registration fees.

All work shall be executed and inspected in accordance with all local and state codes, rules, ordinances, and regulations pertaining to the particular work involved. The Contractor shall be responsible for the completion of all work necessary for a complete and approved installation without extra expense to the Government. Should any changes in the drawings and specifications be required to conform to such ordinances, the Contractor shall notify the Contracting Officer.

3.1.6 Inspection

Contractor shall physically inspect all OWS tanks, equipment and piping material and air test before being installed. Any defects observed shall be immediately brought to the attention of the COTR. It shall be the sole responsibility of the contractor to correct any deficiencies, in accordance with the manufacturer's recommendations, at no additional cost to the

Government.

3.1.7 Installation of the Filter Fabric

The Contractor shall line the sides and bottom of the excavated hole with the filter fabric. Adjoining fabric panels shall be overlapped at least 533 mm. backfill shall be placed on top of the filter fabric to hold it in place.

3.1.8 Dry Holes

Tanks shall be in dry holes. To keep water table down during installation, the Contractor shall provide pumps. Tanks shall not be installed on timber, blocks, or cradles.

3.1.9 Bedding

A 300 mm pea gravel bed for tanks shall be placed on concrete anchor pad. The tank shall be placed on 300 mm thick bed of clean pea gravel; smooth and level, free of voids around and adjacent to the tank. Gravel shall be 6 mm to 20 mm diameter pea gravel with not more than 3 percent passing No. 8 sieve. The gravel shall conform to ASTM C33 (naturally rounded aggregate free flowing). The dry gravel density must be a minimum of 1,523 kilograms per cubic meter.

3.1.10 Concrete Anchor Pad

The concrete pad must extend a minimum of 450 mm beyond the side of the tank and shall be at least equal to the length of the tank. Wire rope must be triple clamped. Exposed metal shall be coated with bitumastic.

3.1.11 Anchor Straps

The Contractor shall secure the tank to the concrete ballast pad with tank manufacturer's recommended straps. Anchor points in concrete at bottom of hole must be aligned within 25 mm from the arrows on the ribs of the tank.

3.1.12 Installation of OWS

The separators shall be pre-packaged, pre-engineered, and ready to install units.

The Contractor shall install the OWS tank with sufficient truck access (top side clearance) to allow removal of oil, sludge, and water.

The OWS tank must be installed in the following position:

A level and plumb position.

The inlet piping sloped to the OWS tank 20.83 mm to 5.208 mm per meter downward to attain proper gravity flow. The effluent piping must be sloped away from the OWS tank following the same pitch.

The OWS tank must be filled with water immediately after installation

and prior to being placed in service.

3.1.13 Backfill

backfill shall be pea gravel and shall be placed evenly in no greater than 300 mm layer. Backfill shall be placed to ensure a complete filling of voids between tank, ballast pad and side of excavations. The Contractor shall place the first 300 mm lift of backfill evenly around the tanks. The backfill shall be pushed completely beneath tank bottom, between ribs and under end caps to provide necessary support. Another 300 mm lift of backfill shall be placed evenly around tanks. After completion of second lift, Contractor may backfill to the top of tanks without additional handwork.

3.1.14 Warranty

Contractor shall complete the installation checklist provided by the manufacturer. The installation contractor must provide a copy of the installation checklist to the COTR to validate any future warranty claim.

3.2 PLACING OWS IN SERVICE

3.2.1 Manufacturer's Instruction

The Contractor shall adhere to Containment Solutions Publication No. OWS 2012 and 2013 for startup requirements.

3.2.2 Filling Tanks

Tanks shall not be filled with water until the backfill is to the top of the tank. Once backfill is to the top of the tank, the Contractor shall fill tank with clean water from an approved hydrant after giving proper notice to the COTR.

-- End of Section --

SECTION 02841

MAINTENANCE OF TRAFFIC
03/93

PART 1 GENERAL

1.1 SUMMARY

The work under this section shall include all labor, materials, equipment, tools and services required to maintain and protect vehicular and pedestrian traffic and the work while the contract is in force in accordance with the provisions of ODOT 614.

1.2 REFERENCES

Wherever the abbreviation ODOT appears in these specifications it should be understood to mean the State of Ohio Department of Transportation Construction and Material Specifications. The "Method of Measurement" and "Basis of Payment" paragraphs shall not apply to this project. Wherever the word "Engineer" appears in the ODOT Specifications, it shall be construed to mean the Contracting Officer's Technical Representative (COTR).

Wherever the word OMUTCD appears in these specifications it should be understood to mean the Ohio Manual of Uniform Traffic Control Device with addendum.

The publications listed below form a part of this section to the extent referenced:

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

| | |
|----------|--|
| ODOT 614 | (1997) Maintaining Traffic and Subparts as Specified |
|----------|--|

1.3 SUBMITTALS (Not Applicable)

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 TRAFFIC CONTROL

The installation, maintenance, and operation of all traffic controls and traffic control devices shall conform to the requirements of the OMUTCD and shall conform to ODOT 614. Temporary pavement markings, traffic signs and channelizing devices will be required.

Vehicular and pedestrian traffic shall in general be maintained during the construction of work except as noted on the contract drawings or elsewhere in the specifications. Short periods of closings are permitted for

installation of temporary crossings over trenches. All closings permitted shall be provided with detour routes by the use of signage and barricades; warning lights shall be provided during hours of darkness.

3.2 TEMPORARY VEHICULAR CROSSING

Temporary vehicular crossing shall be provided in areas as shown on the plans or as may be directed by the COTR. Any crossing provided shall be designed for H20-44 (M18) loading. Shop drawings shall be submitted for all crossings for approval to the COTR prior to installation and use. Necessary protective devices, flashers, barricades or other shall be provided to insure proper channelization of vehicles over same. All such crossings shall meet local, State and Federal codes and law.

Such temporary crossings may be portable for use in different areas as work progresses.

3.3 TEMPORARY PEDESTRIAN CROSSING

Temporary pedestrian crossings shall be provided in areas as shown on the plans or as may be directed by the COTR. Any crossing provided shall be designed for a minimum 391 kilograms per square meter loading. Protective railings shall be provided as a part of the structure; minimum width of travelled part shall be 1.2 m or 2.4 m for double-wide crossings. Shop drawings of all crossings shall be submitted for approval to the COTR prior to fabrication and use.

Such temporary crossings may be portable for use in different areas as work progresses. All necessary signage, barricades, lighting or other shall be provided to insure proper channelization of pedestrians over same. All such crossings shall meet local, State or Federal codes and law.

-- End of Section --

SECTION 02930

LAWNS AND GRASSES

06/93

PART 1 GENERAL

1.1 REFERENCES

STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

ODOT 659 (1997) Seeding and Mulching; and Subparts
as Specified

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330,
"Submittals," in sufficient detail to show full compliance with the
specification:

SD-09 Reports

Laboratory Analysis of Grass Seed for percent pure, percent
germination, and percent weed seed, along with laboratory analysis
of Proposed Top Soil shall be submitted.

1.3 SAMPLING AND TESTING

Sampling and testing of grass seed and topsoil shall be by an approved
testing service and show compliance with all specified requirements.

1.4 DELIVERY AND STORAGE

1.4.1 Seed and Fertilizer

Grass seed and fertilizer shall be delivered in sealed containers or bags,
each labeled in accordance with the applicable federal and state
regulations and bearing the name, trade name or trademark, and
certification of the producer.

Packaged materials shall be stored off the ground, under watertight cover,
and away from damp surfaces.

1.5 WEATHER LIMITATIONS

Topsoil shall not be placed when the subgrade is frozen, excessively wet,
extremely dry or in a condition detrimental to grass seed planting or
finish grading.

Seeding shall be done between Aug. 15 and Oct. 1, or between April 1 and
May 30 unless otherwise permitted by the COTR.

PART 2 PRODUCTS

2.1 TOPSOIL

Topsoil previously removed and stockpiled shall be used in the work. Topsoil shall be free from subsoil, litter, and other objectionable material.

Topsoil shall be fertile, friable, natural surface soil obtained from well-drained areas and possessing characteristics of representative soils in the project vicinity that produce heavy growths of crops, grass, or other vegetation. Topsoil shall be free of material that might be harmful to plant growth or hindrances to planting or maintenance operations.

Chemical and physical properties of topsoil proposed for use in the work shall be as follows:

Organic matter shall be at least 6 percent, but not more than 20 percent, as determined by loss on ignition of moisture-free samples of topsoil.

The pH range shall be from 5.0 to 7.0.

The physical analysis of the topsoil shall be within the following limits:

| <u>SIEVE SIZE</u> | <u>PERCENT PASSING</u> |
|-------------------|------------------------|
| 6.35 mm | 97 to 100 |
| No. 100 | 40 to 60 |
| No. 200 | 20 to 40 |

2.2 GRASS SEED

Grass seed for lawn areas shall be as follows:

| <u>KIND OF GRASS SEED</u> | <u>GRASS SEED IN MIXTURE BY WEIGHT PERCENTAGE</u> | <u>GRASS SEED PURITY MINIMUM PERCENTAGE</u> | <u>GRASS SEED GERMINATION MINIMUM PERCENTAGE</u> |
|---------------------------|---|---|--|
| Kentucky Bluegrass | 40 | 98 | 90 |
| Creeping Red Fescue | 40 | 98 | 90 |
| Annual Ryegrass | 20 | 98 | 90 |

Grass seed which has become wet, moldy, or otherwise damaged in transit or storage will not be acceptable.

2.3 LIME

Lime shall conform to ODOT 659.02.

2.4 FERTILIZER

Fertilizer shall be a complete fertilizer, part of which is derived from organic sources, containing the following percentage by weight:

12% nitrogen
12% phosphorus
12% potassium

2.5 MULCH

Mulch shall be fresh, shredded straw of wheat, rye, oats, or barley and shall be clean and free of seeds.

Mulch that is fresh and excessively brittle or that is in such an advanced stage of decomposition as to smother or retard the growth of grass will not be acceptable.

PART 3 EXECUTION

3.1 TOPSOIL PREPARATION

3.1.1 Subgrade

Before topsoil is placed, the subgrade surface shall be cleared of all materials that might hinder the performance of the work or subsequent maintenance operations.

3.1.2 Grading

Grades on areas that have been previously established shall be maintained in a true and even condition.

Where grades have not been established and where improperly graded, areas shall be uniformly graded. Finished surfaces shall be smooth within a tolerance of 30.5 mm above or below the indicated subgrade elevations, with uniform levels or slopes between the points where elevations are indicated or between such points and existing grades and free from irregular surface changes to prevent the formation of depressions where water will accumulate.

3.1.3 Tillage

Immediately prior to placing the topsoil, the subgrade, wherever excessively compacted by traffic or other cause, shall be loosened to a depth of at least 76.2 mm by plowing, discing, harrowing, or other approved means.

3.1.4 Placing Topsoil

Suitable topsoil shall be placed in the top 101.6 mm of all grassed areas stripped under this project. All areas to receive topsoil, including cut

and fill areas, shall be shaped to provide a minimum of 101.6 mm topsoil. Prior to placement of the topsoil, the subgrade shall be scarified to a depth of 76.2 mm. The topsoil shall be uniformly distributed and evenly spread to an average thickness of 76.2 mm. The spreading shall be performed in such a manner that planting can proceed with little additional soil preparation or tillage, and the area shall be left smooth and suitable for lawns. Irregularities in the surface from topsoiling or other operations shall be corrected so as to prevent the formation of depressions where water will stand. Topsoil shall not be hauled and placed when wet or when the subgrade is frozen, excessively wet, extremely dry or in a condition otherwise detrimental to the proposed planting or to proper grading. Topsoil shall be spread uniformly but shall not be compacted. Where any portion of the surface becomes gullied or otherwise damaged, the affected area shall be repaired to establish the condition and grade prior to topsoiling, and then shall be re-topsoiled.

3.1.5 Application of Lime

The application of lime shall conform to ODOT 659.08.

Lime shall be uniformly distributed over the topsoil surface at a rate of 25 kg per 100 square meter and incorporated into the topsoil to a depth of at least 76.2 mm by discing, harrowing, or other approved means.

3.1.6 Application of Fertilizer

The application of fertilizer shall conform to ODOT 659.08.

Fertilizer shall be uniformly distributed over the topsoil surface at a rate of 12 kg per 100 square meter, and incorporated into the topsoil to a depth of at least 76.2 mm by discing, harrowing, or other approved means.

Fertilizer may be applied mixed with seed and water as specified in paragraph entitled, "Seeding."

3.1.7 Smooth Grading

Undulations or irregularities in the topsoil surface resulting from operations shall be leveled.

The topsoil surface shall be made smooth and uniform.

3.1.8 Cleanup

After smooth grading, the topsoil surface shall be cleared of stones or other objects that might be a hindrance to planting or maintenance operations.

Topsoil or other material that has been brought upon the surfacing of paved areas by operations shall be removed daily.

3.2 SEEDING

3.2.1 Preparation of Seedbed

Preparation of seedbed shall conform to ODOT 659.09.

Seedbed shall be loose and porous at the time of seeding. When necessary, the seedbed shall be loosened to a depth of at least 75 millimeter by harrowing or other suitable means and the surface smooth-graded and cleared of objectionable material as specified.

3.2.2 Mixture Preparation

Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

Mix slurry with nonasphaltic tackifier.

Type A fertilizer (5:10:10) shall be mixed in the slurry to be broadcast at the rate of 39 kilograms per square meter.

3.2.3 Planting

Apply slurry uniformly to all areas to be seeded in a one-step process. apply mulch at the minimum rate of 1,500 pounds per acre (16.5 kilograms per 100 square meter) dry weight, but not less than the rate required to obtain 17.1 kilograms per square meter seed-sowing rate.

Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at the minimum rate of 500 pounds per acre (5.5 kilograms per 100 square meter) dry weight, but not less than the rate required to obtain specified seed-sowing rate. apply slurry cover coat of fiber mulch at a rate of 1,000 pounds per acre (11 kilograms per 100 square meter).

All structures, buildings, walks, roads, and plant materials shall be brushed or swept to remove any mulch impinged thereon.

3.3 MULCHING

3.3.1 Placing Mulch

Placement of mulch shall conform to ODOT 659.09.

Hydro-mulch shall be applied at recommended rates, when hydraulic methods are employed for grass seed application.

Where mechanical methods are employed for grass seed application, areas shall be covered immediately with a uniform blanket of straw mulch not exceeding a loose depth of 38 millimeter.

Straw mulch shall be applied by hand or approved equipment.

3.3.2 Anchoring of Mulch

Where straw mulch is employed, straw mulch shall be anchored with tacking

agents noted in ODOT 659.09, or approved fiber mesh netting.

3.4 GRASS ESTABLISHMENT

3.4.1 General

The period of grass establishment shall begin immediately after the completion of mulching in an area and shall continue for a period of 2-months after the completion of seeding on the entire project unless the desired grass cover is established in a shorter period of time and shortening of the grass-establishment period is authorized.

3.4.2 Watering

Immediately after the completion of mulching in an area, the area shall be moistened to a depth of 75 millimeter or more.

After the initial watering, the seeded areas shall be watered as required to maintain the soil in a moist condition for the entire grass-establishment period.

Watering shall conform to ODOT 659.09.

The Contractor shall provide and maintain temporary piping and lawn-watering equipment required to convey water from the water source to uniformly water the seeded areas. Water shall be free from substances detrimental to the growth of vegetation. Water sources located on Government property will be subject to approval prior to use. Temporary watering equipment shall be removed after grass area acceptance.

Watering schedules shall be arranged and lawn-watering equipment laid out in a manner to avoid the necessity of walking over muddy and newly seeded areas.

Watering shall be done in a manner to prevent the displacement of seed and mulch and to prevent puddling and water erosion.

3.4.3 Weeding

Weeds or other undesirable vegetation that threaten to smother the grass shall be uprooted and removed from the area.

3.4.4 Reseeding

After the first mowing, bare areas shall be reseeded.

Reseeding shall be with the grass seed specified for each seeded area and shall be sown at the rate specified and in a manner that will cause a minimum of disturbance to the existing stand of grass and mulch.

3.4.5 Remulching

In areas where mulch has been disturbed sufficiently to nullify its purpose, new mulch shall be added and anchored as specified.

3.4.6 Refertilizing

After the first mowing and during a period when the grass is dry, fertilizer shall be uniformly distributed over the seeded area at a rate of 1.0 kilogram of actual nitrogen per 93 square meter. Fertilizer shall be as specified.

3.5 ACCEPTANCE PROVISIONS

3.5.1 Acceptance Requirements

Completed grass areas shall have been recently mowed and be covered with a uniform stand of the specified grass, be free of rank growths of weeds or other undesirable vegetation, and be free of irregular surface changes and other depressions where water will accumulate.

Scattered bare spots not larger than 152.4 mm in any dimension will be allowed, up to a maximum of 3 percent of any grass area.

The condition of grass areas at the time of inspection will be noted and a determination, made whether the grass-establishment period shall be extended for any area.

3.5.2 Repairs

If, before completion and acceptance of the entire work, portions of the surface become gullied or otherwise damaged following seeding or the grass seedings have been destroyed, the affected area shall be repaired to re-establish the condition and grade of the soil prior to seeding and then re-seeded, remulched, and the grass established as specified.

3.6 PROTECTION

Seeded areas shall be protected against traffic or other use by erecting barricades around each area immediately after seeding is completed and by placing warning signs of an approved type on each seeded area.

-- End of Section --

SECTION 09915

PAINTING
09/96

PART 1 GENERAL

1.1 REFERENCES (Not Applicable)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for Paint Materials as listed in the paragraph entitled, "General," of this section.

SD-14 Samples

Manufacturer's Standard Color Charts shall be submitted for Paint Materials showing the manufacturer's recommended color and finish selections. Three color chip samples shall be submitted for each color and gloss scheduled.

PART 2 PRODUCTS

2.1 GENERAL

The following are products that meet the required performance standards.

| | <u>PITTSBURG</u> | <u>SHERWIN WILLIAM</u> |
|------------------------------|------------------|----------------------------|
| Inhibitive metal primer | 6-712 | B66WW1 |
| Pigmented sealer | 6-2 | B28W200 |
| Latex block filler | 6-7 | B42W46 |
| Alkali resis- tant primer | 6-3 | A5V2 |
| Enamel undercoat | 6-755 | B49W200 |
| Exterior wood primer | 6-809 | Y24W538 |

| | <u>PITTSBURG</u> | <u>SHERWIN WILLIAM</u> |
|--------------------------|------------------|----------------------------|
| Acrylic latex, flat | 72 line | B36 Series |
| Acrylic latex gloss | 78 line | A-100A8 |
| Water base acrylic epoxy | 16 line | B70/B60V15 |

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Manufacturer's recommendations for surface preparation, thinning, mixing, handling, and applying his product shall be considered a part of this specification.

Surfaces shall be clean, dry, and free from contaminants and foreign matter. Mildew and chalking shall be removed and the surface thoroughly sterilized. Chipped, peeling, or blistered paint shall be removed and the surface spot-primed. Hard glossy surfaces shall be dulled and roughened to ensure proper adhesion.

3.1.1 Metal

Surfaces shall be dry and free from dirt, oil, grease, wax, and other contaminants. Oxide or corrosion shall be removed by hand, power tool, or blast cleaning.

3.1.2 Wood

Surfaces shall be clean, dry, smooth, and free from oil, grease, and dirt. Knots shall be sealed with a mixture of equal parts of shellac and alcohol. Nail holes, cracks, and other defects shall be filled with plastic wood or putty. Concealed surfaces shall be back-primed before installation.

3.1.3 Masonry

Surfaces shall be free from dirt, oil, grease, wax, form-release compounds, laitance, and other contaminants. Large cracks, voids, and other major surface imperfections shall be cleared of loose material and filled with mortar.

3.1.4 Plaster and Drywall

Surfaces shall be clean and dry. Cracks and other surface imperfections shall be filled with spackling compound and sanded smooth.

3.2 MIXING AND APPLICATION

Exterior painting shall not be allowed in rainy weather or when rain is imminent. Paints or coatings shall not be applied when the temperature or humidity exceeds the manufacturer's recommendations.

Each coat of material applied shall be free from evidence of poor application. Variations in color, gloss, and texture shall not be acceptable.

Finish coats shall show good hiding characteristics and uniform appearance.

Newly painted surfaces shall be protected from damage.

There shall be at least 2 coats of paint applied in accordance with the manufacturer's instructions.

Each coat shall be applied uniformly at the wet-film thickness as specified by the manufacturer.

Spot-painting to correct damaged surfaces will be allowed only when touch-up area blends into the surrounding finish. Otherwise, the entire area shall be recoated. Touchup shall be accomplished using the same method of application as was used to apply the original material.

3.3 PROTECTION REQUIREMENTS

"WET PAINT" signs shall be posted to indicate newly painted surfaces.

3.4 PAINT SCHEDULE

| <u>SURFAC</u> | <u>PRIME</u> | <u>UNDERCOAT AND FINISH COA</u> | <u>FINISH COLOR AND SHEEN</u> |
|---------------------------------------|--------------------------------|---|---------------------------------------|
| Interior metal | Inhibitive metal primer | Water-base acrylic enamel | Match Existing |
| Interior masonry (rough/porous) | Latex block filler | Water-base acrylic enamel | Match Existing |
| Interior masonry (smooth) | Pigmented sealer | Water-base acrylic enamel | Match Existing |
| Exterior masonry (rough/porous) | Latex block filler | Acrylic latex | Match Existing |
| Exterior masonry (smooth) | Alkali- resistant primer | Acrylic latex | Match Existing |
| Interior wood | Water-base enamel | Water-base acrylic enamel | Match Existing |

| <u>SURFAC</u> | <u>PRIME</u> | UNDERCOAT AND <u>FINISH COA</u> | FINISH COLOR <u>AND SHEEN</u> |
|---------------------|-------------------------|---------------------------------------|-------------------------------------|
| | undercoat | | |
| Exterior wood | Exterior wood primer | Acrylic latex | Match Existing |
| Interior plaster | Pigmented sealer | Water-base acrylic enamel | Match Existing |
| Interior drywall | Pigmented sealer | Water-base acrylic enamel | Match Existing |

-- End of Section --

SECTION 15003

GENERAL MECHANICAL PROVISIONS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1 (1981; R 1993) Scheme for the
Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123 (1989; Rev A) Standard Specification for
Zinc (Hot-Dip Galvanized) Coatings on Iron
and Steel Products

ASTM B 766 (1986; R 1993) Standard Specification for
Electrodeposited Coatings of Cadmium

MILITARY SPECIFICATIONS (MS)

MS MIL-T-704 (Rev K) Treatment and Painting of Material

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION
(SMACNA)

SMACNA-08 (1991, 1st Ed.) Seismic Restraint Manual
Guidelines for Mechanical Systems
(Available only from 401 Shatto Place, No.
101, Los Angeles, CA 90020) Sheet Metal
Industry Fund (SMIF)

UNDERWRITERS LABORATORIES (UL)

UL 6 (1993; 10th Ed) UL Standard for Safety -
Rigid Metal Conduit

UL-02 (1995) Building Materials Directory

1.2 SUBMITTALS (Not Applicable)

1.3 COORDINATION

Contractor shall coordinate the work of the different trades so that interference between piping, equipment, structural, and electrical work will be avoided. All necessary offsets in piping and all fittings, etc.,

required to install the work properly shall be furnished complete in place at no additional cost to the Government.

1.4 MECHANICAL SYSTEMS IDENTIFICATION

1.4.1 Diagrams

Chart listing of equipment shall be by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics. This requirement shall not apply for accessories or minor equipment items, such as vents, but is required for such equipment as pumps, water heaters, air-handling system equipment, refrigeration compressors, heat exchangers, and boilers.

Diagrams shall be neat mechanical drawings provided with extruded aluminum frames and 6 millimeter acrylic plastic protection. Location shall be as directed by the Contracting Officer. The number of charts and diagrams shall be equal to or greater than the number of mechanical equipment rooms. Where more than one chart per space is required, these shall be mounted in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.4.2 Identification Tags

Identification tags made of brass or aluminum indicating function of a control or similar component shall be installed on such system devices. Tags shall be 50 millimeter in diameter and marking shall be stamped.

Equipment shall be provided with metal identification tags displaying an equipment designation number matching drawing or control diagram designation.

Tags shall be wired to valve or equipment items with No. 12 AWG 2 millimeter diameter corrosion-resistant steel wire.

1.4.3 Service Labeling

All piping, including that concealed in accessible spaces; exposed, bare and painted; and insulated, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels and valve tag schedule shall be in accordance with the typical examples below:

| <u>SERVIC</u> | <u>LABEL AND TAG DESIGNATION</u> |
|-------------------------------|----------------------------------|
| Gas furnace | GAS FURNACE NO. 1 |
| Supply air fan no. 2 | S.A.F. NO. 2 |
| Storm drain | STORM DRAIN |
| Automatic temperature control | AUTO. TEMP. CONTROL |

| <u>SERVIC</u> | <u>LABEL AND TAG DESIGNATION</u> |
|---------------|----------------------------------|
| Natural gas | NG () PSIG |

Similar services with different temperatures or pressures shall be identified. Where pressures may exceed 860 kilopascal, the maximum system pressure shall be included in the label.

Piping shall be labeled and arrowed in accordance with the following:

Each point of entry and exit of pipe passing through walls

Each change in direction, i.e., elbows, tees

In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

In long straight runs, labels shall be located at distances within eyesight of each other but in no case shall the distance between labels exceed 20 meter. All labels shall be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes
for Outside Diameters o

Lettering

13 thru 39 millimeter

13 millimeter

40 thru 64 millimeter

13 millimeter

Labels shall be made of self-sticking, plastic film designed for permanent installation.

1.5 COLOR CODING

Color coding of all piping systems shall be in accordance with ANSI A13.1.

1.6 APPROVAL REQUIREMENTS

Except as otherwise specified, approval of materials and equipment will be based on manufacturer's published data.

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL-02, and UL 6 will be acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, the Contractor may submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Methods of testing used by the specified agencies shall be outlined.

Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the American Society for Testing and Materials (ASTM), the American Society of Mechanical Engineers (ASME), or other standards, a manufacturer's certificate of compliance of each item

will be acceptable as proof of compliance.

Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given rust-inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with earth, and where connected to dissimilar metal, shall be protected by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123 for exterior locations and cadmium-plated in conformance with ASTM B 766 for interior locations.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, engraved laminated phenolic identification plates shall be provided for each piece of mechanical equipment. Identification plates shall designate the function of the equipment. Designation shall be submitted with the shop drawings.

Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 40 millimeter high and smaller shall be 1.6 millimeter thick, with engraved lettering 3 millimeter high; identification plates larger than 40 millimeter high shall be 3 millimeter thick, with engraved lettering of suitable height. Identification plates 40 millimeter high and larger shall have beveled edges. Identification plates shall be installed using a compatible adhesive.

2.2 SEISMIC ANCHORAGE

Equipment shall be anchored in accordance with applicable seismic criteria for the area and as defined in SMACNA-08.

2.3 PAINTING

Equipment units shall be painted in accordance with MS MIL-T-704 or in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouching shall be accomplished only if approved; otherwise equipment shall be returned to the factory for refinishing.

PART 3 EXECUTION

3.1 INSTALLATION

Materials and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers. Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations.

3.2 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching of the building structure.

Holes in exposed locations, in or through existing floors, shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

Holes through masonry walls to accommodate sleeves shall be made with an iron pipe masonry core saw.

3.3 CLEANING

Exposed surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish painting or are enclosed within the building structure.

Before final acceptance, mechanical equipment, including piping, ducting, and fixtures, shall be clean and free from dirt, grease, and finger marks.

-- End of Section --

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S328 (1986) Specification for Structural Steel Buildings Load and Resistance Factor Design

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 197M (1987; R 1992) Standard Specification for Cupola Malleable Iron (Metric)

ASTM A 234/A 234M (1997) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A 53 (1996) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 563M (1996) Standard Specification for Carbon and Alloy Steel Nuts (Metric)

ASTM C 109/C 109M (1995) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)

ASTM C 190 (1985) Standard Test Method for Tensile Strength of Hydraulic Cement Mortars

ASTM C 404 (1994) Standard Specification for Aggregates for Masonry Grouts

ASTM C 476 (1991) Standard Specification for Grout Masonry

ASTM C 67 (1994) Standard Test Methods of Sampling and Testing Brick and Structural Clay Tile

ASTM C 920 (1995) Standard Specification for Elastomeric Joint Sealants

ASTM F 104 (1995) Standard Classification System for Nonmetallic Gasket Materials

ASTM F 568 (1995) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3 (1992) Malleable-Iron Threaded Fittings, Classes 150 and 300

ASME B16.39 (1986) Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300

ASME B16.5 (1996) Pipe Flanges and Flanged Fittings

ASME B16.9 (1993) Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.3 (1996) Chemical Plant and Petroleum Refinery Piping

ASME-17 (1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS-02 (1990) Welding Handbook; Eighth Ed; Vol Two - Welding Process

FEDERAL SPECIFICATIONS (FS)

FS FF-S-325 (Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

MILITARY SPECIFICATIONS (MS)

MS MIL-C-18480 (Rev B; Notice 1) Coating Compound, Bituminous, Solvent, Coal-Tar Base

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1990) Cast Iron Gate Valves, Flanged and

Threaded Ends

MSS SP-72

(1992) Ball Valves with Flanged or
Butt-Welding Ends for General Service

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Pipe and Fittings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements
Spare Parts

SD-04 Drawings

As-Built Drawings shall be submitted for Pipes, Valves, and Accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

SD-19 Operation and Maintenance Manuals

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Test data shall be legible and of good quality.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Type BCS, Black Carbon Steel

Pipe (DN6 through DN300) shall be Schedule 40 black carbon steel, conforming to ASTM A 53.

Pipe (DN6 through DN250) shall be Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53, Type S (seamless). Grade A should be used for permissible field bending,

in both cases.

Pipe (DN300 through DN610) shall be 9.52 millimeter wall seamless black carbon steel, conforming to ASTM A 53, Type S (seamless).

Fittings (DN50 and under) shall be 1034 kilopascal working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A 197M and ASME B16.3.

Unions (DN50 and under) shall be 1724 kilopascal (250 psi) female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39.

Fittings (DN65 and over) shall be Steel butt weld, conforming to ASTM A 234/A 234M and ASME B16.9 to match pipe wall thickness.

Flanges (DN65 and over) shall be 1034 kilopascal (150-pound) forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.2 VALVES

2.2.1 Gate Valves (GAV)

Gate valves DN50 and smaller shall conform to MSS SP-72. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Packing shall be made of non-asbestos type materials. Valves shall be rising stem type.

Gate valves DN65 and larger, shall be Type I, (wedge disk, tapered seats, steam rated); Class I (862 kilopascal steam-working pressure at 178 degrees C saturation); and 1379 kilopascal, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Valves shall be flanged, with bronze trim and outside screw and yoke (OS&Y) construction. Packing shall be made of non-asbestos type materials.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavybodied material to produce not less than a 0.30 millimeter dry-film thickness in one coat, and shall be as recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type, conforming to MS MIL-C-18480.

2.3.2 Bolting

Flange and general purpose bolting shall be hex-head and shall conform to ASTM F 568, Class 4.8 or above (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A 563M. Square-head bolts and nuts are not acceptable. Threads shall

be coarse-thread series.

2.3.3 Elastomer Caulk

Polysulfide- or polyurethane-base elastomer caulking material shall be two-component type, conforming to ASTM C 920.

2.3.4 Flange Gaskets

Compressed non-asbestos sheet, conforming to ASTM F 104, Type 7-P1161A, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 399 degrees C.

2.3.5 Grout

Shrink-resistant grout shall be a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C 404 and ASTM C 476.

Shrink-resistant grout shall be a combination of premeasured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

| | | |
|---|-------------------|----------------------------------|
| Tensile strength | ASTM C 190 | 13.100 Megapascal, minimum |
| Compressive strength | ASTM C 109/C 109M | 96.527 Megapascal, minimum |
| Shrinkage, linear | | 0.003 mm per millimeter, maximum |
| Water absorption | ASTM C 67 | 0.1 percent, maximum |
| Bond strength to steel in shear minimum | | 6.895 Megapascal, minimum |

2.3.6 Pipe Thread Compounds

Tetrafluoroethylene tape not less than 0.05 to 0.08 millimeter thick shall be used in potable and process water and in chemical systems for pipe sizes to and including DN25. Tetrafluoroethylene dispersions and other suitable compounds may be used for all other applications upon approval; however, no lead-containing compounds may be used in potable water systems.

2.4 SUPPORTING ELEMENTS

All necessary piping systems and equipment supporting elements shall be provided, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. All supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements shall conform to requirements of ASME B31.3, FS FF-S-325, MSS SP-58, and MSS SP-69 except as noted.

Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Supporting elements exposed to weather shall be hot-dip galvanized. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with FS FF-S-325. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

2.4.1 Building Structure Attachments

2.4.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to FS FF-S-325 for the following types:

Group I - shield, expansion (lead, bolt and stud anchors)

Group II - shield, expansion (bolt anchors)

Type 2 - machine bolt expansion shield anchors

Class 2 - open-end expansion shield anchors

Style 1 - single-end expansion shield anchors

Style 2 - double-end expansion shield anchors

Group III - shield, expansion (self-drilling

tubular expansion shell bolt anchors)

Group VIII - anchors, expansion (nondrilling)

Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

2.4.1.2 Inserts, Concrete

Concrete inserts shall be Type 18 or 19. When applied to piping in sizes DN50 and larger and where otherwise required by imposed loads, a 305 millimeter length of 13 millimeter reinforcing rod shall be inserted and wired through wing slots. Proprietary-type continuous inserts may be submitted for approval.

2.4.2 Vertical Pipe Attachments

Vertical pipe attachments shall be Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.4.3 Hanger Rods and Fixtures

Only circular cross section rod hangers may be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.4.4 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with AISC S328.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Piping systems shall be fabricated and installed in accordance with ASME B31.3, MSS SP-69, and AWS-02.

Final connections to equipment shall be made with flanges.

All pipe ends shall be reamed before joint connections are made.

Screwed joints shall be made up with specified joint compound and not more than three threads shall show after joint is made up.

Joint compounds shall be applied to the male thread only and care shall be exercised to prevent compound from reaching the unthreaded interior of the pipe.

Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Piping systems shall be securely supported with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Field welded joints shall conform to the requirements of the AWS-02, ASME B31.3, and ASME-17.

3.2 SUPPORTING ELEMENTS INSTALLATION

Supporting elements shall be provided in accordance with the referenced codes and standards.

Piping shall be supported from building structure. No piping shall be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than DN15 of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Piping support elements shall be installed at intervals specified hereinafter, at locations not more than 900 millimeter from the ends of each runout, and not over 300 millimeter from each change in direction of piping.

Vertical risers shall be supported independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers shall be guided for lateral stability. For risers subject to expansion, only one rigid support shall be provided at a point approximately one-third down from the top. Clamps shall be placed under fittings unless otherwise specified. Carbon-steel pipe shall be supported at each floor and at not more than 4572 millimeter intervals for pipe DN50 and smaller and at not more than 6096 millimeter intervals for pipe DN65 and larger.

3.3 PENETRATIONS

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces shall include space above ceilings where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

3.4 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, all piping shall be cleaned, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

Suspect cast-ferrous piping shall be further inspected by painting with kerosene on external surfaces to reveal cracks.

Defective materials found shall be distinctly marked using a road-traffic quality yellow paint; defective material shall be promptly removed from the

site.

After conduit has been inspected, and not less than 48 hours prior to being lowered into a trench, all external surfaces of cast ferrous conduit shall be coated with a compatible bituminous coating for protection against brackish ground water. Application shall be single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 0.30 millimeter.

Excavations shall be dry and clear of extraneous materials when pipe is being laid.

Cutting of piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting will not be permitted.

Laying of pipe shall begin at the low point of a system. When in final acceptance position, it shall be true to the grades and alignment indicated, with unbroken continuity of invert. Blocking and wedging will not be permitted.

Bell or grooved ends of piping shall point upstream.

Changes in direction shall be made with long sweep fittings.

Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Rods, clamps, and bolting shall be protected with a coating of bitumen.

Underground piping below supported or suspended slabs shall be supported from the slab with a minimum of two supports per length of pipe. Supports shall be protected with a coating of bitumen.

On excavations that occur near and below building footings, the backfilling material shall consist of 13800 kilopascal cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

Vertical downspouts; soil, waste, and vent stacks; water risers; and similar work shall be properly supported on approved piers at the base and provided with approved structural supports attached to building construction.

-- End of Section --

SECTION 16003

GENERAL ELECTRICAL PROVISIONS
02/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123 (1989; Rev A) Standard Specification for
Zinc (Hot-Dip Galvanized) Coatings on Iron
and Steel Products

FEDERAL STANDARDS (FED-STD)

FED-STD 595 (Rev B) Colors Used in Government
Procurement

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1993) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL-05 (1995) Electrical Construction Materials
Directory

1.2 SUBMITTALS (Not Applicable)

1.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

It is the intent of these specifications and the contract drawings to provide a complete and workable facility.

Design drawings are diagrammatic and do not show all offsets, bends, elbows, or other specific elements that may be required for proper installation of the work. Such work shall be verified at the site. Additional bends and offsets, and conduit as required by vertical and horizontal equipment locations or other job conditions, shall be provided to complete the work at no additional cost to the Government.

Except where shown in dimensional detail, the locations of switches, receptacles, lights, motors, outlets, and other equipment shown on plans are approximate. Such items shall be placed to eliminate interference with

ducts, piping, and equipment. Exact locations shall be determined in the field. Door swings shall be verified to ensure that light switches are properly located.

Equipment sizes indicated are minimum. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and shall install wire, conduit, disconnect switches, motor starters, heaters, circuit breakers, and other items of the correct size for the equipment actually installed. Wire and conduit sizes shown on the drawings shall be taken as a minimum and shall not be reduced without written approval.

1.4 CODES AND STANDARDS

Equipment design, fabrication, testing, performance, and installation shall, unless shown or specified otherwise, comply with the applicable requirements of NFPA 70 and IEEE C2.

1.5 COORDINATION

Installation of the electrical work shall be coordinated with the work of other trades.

1.6 APPROVAL REQUIREMENTS

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories (UL), Inc., the label of, or listing with re-examination, in UL-05 will be acceptable as sufficient evidence that the items conform to the requirements.

Where materials or equipment are specified to be constructed or tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized standards, a manufacturer's certificate of compliance indicating complete compliance of each item with the applicable NEMA, ANSI, ASTM, or other commercial standards specified will be acceptable as proof of compliance.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given a rust-inhibiting treatment and the standard finish by the manufacturer. Aluminum shall not be used in contact with earth. Dissimilar metals in intimate contact shall be protected by approved fittings, barrier material, and treatment. Ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123 for exterior locations.

PART 2 PRODUCTS

2.1 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or slabs.

2.2 SEISMIC ANCHORAGE

Electrical equipment, except communications, emergency, and standby equipment, shall be anchored to withstand a lateral force of 0.3 times the weight of the equipment.

Communications, emergency, and standby equipment shall be anchored to withstand a lateral force of 0.6 times the weight of the equipment.

The following standard anchoring should be adequate for equipment not classified as communications, emergency, or standby:

Dry transformers - floor-mounted with four anchor bolts

BOLT DIAMETER

| | | |
|----------------|---|-----|
| Under 150 kVA | - | M10 |
| 150 to 500 kVA | - | M14 |
| Over 500 kVA | - | M16 |

Panels - floor-mounted with four M14 diameter anchor bolts

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations.

3.2 PAINTING APPLICATION

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks, if not factory painted, shall be thoroughly cleaned and painted as specified in Section 09915, "Painting," unless otherwise noted. Work shall be left in a neat and clean condition at final completion of the contract.

Emergency equipment, such as fire-alarm boxes, shall be cleaned, primed, and painted red. Color shall conform to FED-STD 595, Color 11105.

3.3 IDENTIFICATION PLATE INSTALLATION

Identification plates shall be fastened by means of corrosion-resistant steel or nonferrous metal screws. Hand lettering, marking, or embossed self-adhesive tapes are not acceptable.

3.4 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching on the building structure.

Holes in or through existing masonry walls and floors in exposed locations

shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

3.5 DAMAGE TO WORK

Required repairs and replacement of damaged work shall be done as directed by and subject to the approval of the Contracting Officer, and at no additional cost to the Government.

3.6 CLEANING

Exposed surfaces of wireways, conduit systems, and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish or painting or are enclosed within the building structure.

Before final acceptance, electrical equipment, including lighting fixtures and glass, shall be clean and free from dirt, grease, and fingermarks.

3.7 FIELD TESTING AND TEST EQUIPMENT

All Field testing specified in Divisions 16 electrical specification shall be made with test equipment specially designed and calibrated for the purpose. Test equipment used shall be calibrated and certified by an approved testing laboratory. Date of last calibration and certification shall not be more than 90 days old at the time of field testing.

-- End of Section --

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

CABO A117.1 (1992) American National Standards for Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA FB 1 (1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies

NEMA OS 1 (1989) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA RN 1 (1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 13 (1993) Electrical Nonmetallic Tubing (ENT)

NEMA WD 1 (1983; Rev 1989) General Requirements for Wiring Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1 (1993) UL Standard for Safety - Flexible Metal Conduit

UL 1242 (1983; 1st Ed, June 26, 1991) UL Standard for Safety - Intermediate Metal Conduit

UL 489 (1991; 8th Ed; May 1, 1992; Bulletin Feb 11, 1992; Bulletin Mar 16, 1992) UL Standard for Safety Molded-Case Circuit

Breakers and Circuit-Breaker Enclosures

| | |
|--------|--|
| UL 6 | (1993; 10th Ed) UL Standard for Safety - Rigid Metal Conduit |
| UL 797 | (1993; 6th Ed) UL Standard for Safety - Electrical Metallic Tubing |
| UL 870 | (1995; 7th Ed) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings |

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Conduit, Raceway and Fittings
Wire and Cable
Splices and Connectors
Switches
Receptacles
Outlets, Outlet Boxes, and Pull Boxes
Circuit Breakers
Lamps and Lighting Fixtures
Spare Parts

SD-06 Instructions

Manufacturer's Instructions shall be submitted including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

SD-07 Schedules

Material, Equipment, and Fixture Lists shall be submitted for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Conduit, Raceway and Fittings
Wire and Cable
Splices and Connectors
Switches
Receptacles
Outlets, Outlet Boxes, and Pull Boxes
Circuit Breakers

Lamps and Lighting Fixtures

1.3 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall have the standard finish by the manufacturer. Aluminum shall not be used in contact with earth and, where connected to dissimilar metal, shall be protected by approved fittings and treatment. Ferrous metals such as but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall be in accordance with UL 6 and shall be galvanized by the hot-dip process. For underground use and in corrosive areas, rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1 or shall be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and shall be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and shall be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat type fittings.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall be in accordance with UL 1 and shall be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Liquidtight flexible metallic conduit shall be provided with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to

protect wiring against moisture, oil, chemicals, and corrosive fumes.

Fittings for liquidtight flexible metallic conduit shall be specifically designed for such conduit.

2.1.4 Intermediate Metal Conduit

Intermediate metal conduit shall be in accordance with UL 1242 and shall be galvanized.

2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall be in accordance with NEMA TC 13 and shall be PVC with wall thickness not less than Schedule 40.

2.1.6 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 100 by 100 millimeter trade size conforming to UL 870.

2.1.7 Surface Raceways and Assemblies

Surface metal raceways and multi-outlet assemblies shall conform to NFPA 70. Receptacles shall conform to NEMA WD 1, Type 5-20R.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN, THWN, or XHHW. All conductors shall be stranded.

Flexible cable shall be Type SO and shall contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Splices in 3.15 millimeter diameter (AWG No. 8) and smaller shall be made with approved insulated scotchlock, or equal, connectors.

Splices in 4.1 millimeter diameter (AWG No. 6) and larger shall be made with indenter crimp-type connectors and compression tools. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with NEMA FB 1 and NEMA OS 1 and shall be not less than 40 millimeter deep. Pull and junction boxes shall be furnished with screw-fastened covers.

2.5 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated

and in no event less than 10,000 amperes root-mean-square (rms) symmetrical at 208 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489. When providing circuit breakers, or existing panels, provide breakers designed for the panel into which it is being installed.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain not more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Crushed or deformed conduit shall not be installed. Trapped conduit runs shall be avoided where possible. Care shall be taken to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clogged conduit shall be cleared of obstructions or shall be replaced.

3.1.1 Rigid Steel Conduit

Field-made bends and offsets shall be made with approved hickey or conduit bending machine. Conduit elbows larger than 65 millimeter shall be long radius.

Conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, shall be provided with a flush coupling when the floor slab is of sufficient thickness. Otherwise, a floor box shall be provided and set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall be used to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily

locations and to complete the connection to motor-driven equipment.

3.1.4 Intermediate Conduit

Field-made bends and offsets shall be made with approved hickey or conduit bending machine. Intermediate metal conduit shall be used only for indoor installations.

3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and shall be solidly connected to ground at each end. Grounding wires shall be sized in accordance with NFPA 70.

3.1.6 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Unused conduit openings shall be plugged.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and shall be not more than 9000 millimeter long.

3.1.7 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

| <u>CONDUCTOR</u> | <u>480/277 VAC</u> | <u>120/208 VAC</u> |
|-------------------|--------------------|--------------------|
| Phase A | Brown | Black |
| Phase B | Orange | Red |
| Phase C | Yellow | Blue |
| Neutral | White | White |
| Equipment Grounds | Green | Green |

Conductors up to and including 6.5 millimeter diameter (AWG No. 2) shall be manufactured with colored insulating materials. Conductors larger than 6.5 millimeter diameter (AWG No. 2) shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splices shall be in accordance with the NFPA 70. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.3 BOXES AND FITTINGS

Pullboxes shall be furnished and installed where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 30 meter or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with CABO A117.1 and as follows:

| <u>LOCATIO</u> | <u>MOUNTING HEIGHT</u> |
|-------------------------------------|------------------------|
| Receptacles in offices | 450 millimeter |
| Receptacles in corridors | 450 millimeter |
| Receptacles in shops & laboratories | 1200 millimeter |
| Receptacles in rest rooms | 1200 millimeter |
| Switches for light control | 1200 millimeter |

3.4 LAMPS AND LIGHTING FIXTURES

New lamps of the proper type and wattage shall be installed in each fixture. Fixtures and supports shall be securely fastened to structural members and shall be installed parallel and perpendicular to major axes of structures.

3.5 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09915, "Painting."

3.6 FIELD TESTING

After completion of the installation and splicing, joints, and terminations, and prior to energizing the conductors, wire and cable shall be given continuity and insulation tests before the conductors are

energized.

Final acceptance will depend upon the satisfactory performance of equipment. No conductor shall be energized until the installation has been approved.

-- End of Section --

SECTION 16145

STANDARD WIRING SYSTEMS
11/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|------------|--|
| ANSI C80.1 | (1990) Rigid Steel Conduit - Zinc Coated |
| ANSI C80.3 | (1991) Electrical Metallic Tubing - Zinc-Coated |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|--|
| ASTM A 123 | (1989; Rev A) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM D 2301 | (1988; R 1993) Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- | | |
|--------------|---|
| IEEE Std 383 | (1974; R 1992) Standard for Type Test Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations |
|--------------|---|

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

- | | |
|-----------|---|
| NEMA FB 1 | (1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies |
| NEMA PR 4 | (1983; R 1989) Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type for Industrial Use |
| NEMA RN 1 | (1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit |

| | |
|-----------|--|
| NEMA TC 3 | (1990) PVC Fittings for Use With Rigid PVC Conduit and Tubing |
| NEMA WC 5 | (1992) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy |
| NEMA WD 1 | (1983; Rev 1989) General Requirements for Wiring Devices |
| NEMA WD 6 | (1988) Wiring Devices - Dimensional Requirements |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---------|---------------------------------|
| NFPA 70 | (1999) National Electrical Code |
|---------|---------------------------------|

UNDERWRITERS LABORATORIES (UL)

| | |
|---------|--|
| UL 1 | (1993) UL Standard for Safety - Flexible Metal Conduit |
| UL 1242 | (1983; 1st Ed, June 26, 1991) UL Standard for Safety - Intermediate Metal Conduit |
| UL 1581 | (1991; 2nd Ed; Dec 17, 1991) UL Standard for Safety - Reference Standard for Electrical Wires, Cables, and Flexible Cords |
| UL 486C | (1991; 2nd Ed; Oct 10, 1991) UL Standard for Safety Splicing Wire Connectors |
| UL 50 | (1995; 11th Ed) UL Standard for Safety - Enclosures for Electrical Equipment |
| UL 514A | (1991; 8th Ed) UL Standard for Safety - Metallic Outlet Boxes |
| UL 514B | (1989; 2nd Ed; Aug 9, 1990; Errata 1991; Bulletin Sept 16, 1991; Bulletin Jan 20, 1992) UL Standard for Safety Fittings for Conduit and Outlet Boxes |
| UL 6 | (1993; 10th Ed) UL Standard for Safety - Rigid Metal Conduit |
| UL 651 | (1995; 6th Ed; Dec 4, 1989) UL Standard for Safety Schedule 40 and 80 Rigid PVC Conduit |
| UL 797 | (1993; 6th Ed) UL Standard for Safety - Electrical Metallic Tubing |

| | |
|--------|---|
| UL 83 | (1991; 10th Ed) UL Standard for Safety Thermoplastic-Insulated Wires and Cables |
| UL 870 | (1995; 7th Ed) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fitting |

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

- Conduit, Raceways and Fittings
- Wire and Cable
- Safety Switches
- Flush Wiring Devices
- Boxes and Fittings
- Communication Cabinets

SD-04 Drawings

Fabrications Drawings shall be submitted for the Standard Wiring Systems consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents.

SD-07 Schedules

Material, Equipment, and Fixture Lists shall be submitted for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

- Conduit, Raceways and Fittings
- Wire and Cable
- Safety Switches
- Flush Wiring Devices
- Boxes and Fittings
- Communication Cabinets

SD-09 Reports

Test Reports shall be submitted for Standard Wiring Systems in

accordance with the paragraph entitled, "Field Testing," of this section.

SD-18 Records

Test Readings, including the method of testing and the environmental conditions of the test, shall be recorded and submitted to the Contracting Officer.

PART 2 PRODUCTS

2.1 CONDUITS, RACEWAYS, AND FITTINGS

Conduit shall be 15 millimeter diameter minimum.

Conduit, connectors, and fittings shall be approved for the installation of electrical conductors.

2.1.1 Intermediate Metal Conduit

Intermediate metal conduit, including couplings, elbows, bends, and nipples, for use as a raceway for wire and cables in an electrical system shall conform to the requirements of UL 1242 as amended for thin or thick-wall types and shall also conform to NFPA 70. Interior and exterior surfaces of the conduit shall be protected with a metallic zinc coating.

2.1.2 Rigid Steel Conduit

Rigid steel conduit, including couplings, elbows, bends, and nipples, shall conform to the requirements of UL 6 and ANSI C80.1. Steel fittings shall be galvanized by the hot-dip process. Where indicated, and in corrosive areas, rigid steel conduit shall be polyvinylchloride (PVC) coated and conform to NEMA RN 1, Type 20.

Fittings for rigid steel conduit shall be threaded and shall conform to NEMA FB 1.

Gaskets shall be solid for fittings sized 40 millimeter and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and shall be accessible after the work has been completed.

2.1.3 Rigid Plastic Conduit

PVC conduit shall be not lighter than Schedule 40. Rigid PVC shall be the slip-joint solvent-weld type, and fittings shall be unthreaded solid PVC. Conduit and fittings shall conform to UL 651 and NEMA TC 3.

2.1.4 Electrical Metallic Tubing (EMT)

EMT shall be rigid metallic conduit of the thinwall type in straight lengths, elbows, or bends and shall conform to ANSI C80.3 and the requirements of UL 797.

Couplings and connectors shall be hex-nut expansion-gland type, zinc-plated. Crimp, spring, or setscrew type fittings are not acceptable. Where EMT enters outlet boxes, cabinets, or other enclosures, connectors shall be the insulated-throat type, with a locknut. Fittings shall meet the requirements of NEMA FB 1.

2.1.5 Flexible Metallic Conduit

Flexible metallic conduit shall meet the requirements of UL 1.

Liquidtight flexible metallic conduit shall be provided with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Fittings for flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.

Fittings for liquidtight flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Class 3 liquidtight flexible metallic conduit connectors.

2.1.6 Wireways and Auxiliary Gutters

Wireways and auxiliary gutters for use in exposed, dry locations shall be a prefabricated channel-shaped sheet metal trough with hinged or removable covers, associated fittings, and supports for housing, and protecting electrical wires and cables in accordance with UL 870.

Straight sections of trough, elbows, tees, crosses, closing plates, connectors, and hanging brackets shall be constructed from sheet steel of commercial quality not less than 1.6 millimeter. Sheet metal component parts shall be cleaned, phosphatized, and coated with a corrosion-resistant gray paint.

Straight sections of wireways and auxiliary gutters shall be solid or have knockouts as indicated in both sides and bottom, 75 millimeter on center.

Straight sections shall be not more than 1500 millimeter long, with covers held closed with screws.

2.1.7 Surface Metal Raceways

Surface metal raceways shall conform to the requirements of NFPA 70. Minimum size shall equal or exceed the capacity of 15 millimeter trade size conduit.

2.1.8 Surface Multiple-Outlet Assemblies

Surface multiple-outlet assemblies shall conform to the requirements of

NFPA 70 and shall be provided with receptacles conforming to NEMA WD 1, NEMA PR 4 and NEMA WD 6, Figure 5-15R.

2.2 WIRE AND CABLE

Insulated current-carrying wire and grounding conductors shall be copper and shall conform to NFPA 70 and UL 1581. Wire bundles with cable ties shall be secured to the enclosure with sheet-metal screws. Self-sticking adhesive attachments are not acceptable.

2.2.1 Building Wire

Building wire for use in conduits, raceways, and wireways shall be single-conductor, 600-volt, heat- and moisture-resistant insulated wire suitable for use in wet or dry locations.

Conductors shall be stranded round copper wire. Conductors shall be not less than AWG No. 12, except that AWG No. 14 shall be stranded copper wire and shall be used for control wiring.

Building wire shall be Type THHN/THWN with insulation of PVC and nylon jacket, with a minimum temperature rating of 90/75 degrees C.

2.2.2 Cable Tray Wire

Power and control wire installed in cable trays shall be Type TC cable 600 volts, with current-carrying capacity as determined by NFPA 70. Cable shall also comply with UL 83 and IEEE Std 383.

2.2.3 Standard Flexible Cable

Flexible multiconductor cable shall conform to UL 1581 for control and power below 600 volts, noninstrumentation type. Cable shall contain one (green) grounding conductor and shall utilize a thermosetting or thermoplastic overall jacket in accordance with NEMA WC 5. A white conductor shall be included for the power neutral or grounded current-carrying conductor. Cable conductor insulation shall conform to NEMA WC 5.

2.2.4 Splices and Connectors

Splices in building wire AWG No. 8 and smaller and multiple conductor cables shall be made with insulated Scotchlock, or equal, connectors or with indenter crimp-type connectors and compression tools to ensure a satisfactory mechanical and electrical joint.

Splices in building wire AWG No. 6 and larger and single-conductor cables shall be made with indenter crimp-type connectors and compression tools or with bolted clamp-type connectors to ensure a satisfactory mechanical and electrical joint.

Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

Vinyl-plastic electrical insulating tape shall meet the requirements of ASTM D 2301. Where pressure-sensitive tape is used, the surface shall be cleaned free of dust, sand, or other foreign material and a primer recommended by the tape manufacturer shall be applied prior to taping.

For building wire AWG No. 14 and larger, terminations shall utilize set-screw pressure terminal lugs.

Solid wiring shall be terminated with terminal blocks specifically designed for solid wire. Crimp type shall not be used on solid wire for termination.

Stranded wire shall use crimp spade type lugs for termination on terminal blocks.

2.3 BOXES AND FITTINGS

Boxes shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70 and UL 514A. Boxes that are exposed to the weather or that are in normally wet locations shall be cast-metal with threaded hubs. Surface-mounted boxes on interior walls shall be cast-metal. Boxes in other areas shall be zinc-coated sheet metal.

2.3.1 Sheet Metal Boxes and Outlets

Outlet, switch, and junction boxes flush-mounted in walls or ceilings shall be octagon, square or rectangular -shaped gang boxes as appropriate, with extension rings and covers.

Ceiling outlet boxes, from which surface- and pendant-mounted lighting fixtures are supported, shall be not less than 100 millimeter octagonal or square, with plaster rings 40 millimeter deep and shall be capable of withstanding a vertical downward force of 890 newton for 5 minutes. All boxes in spaces above suspended ceilings shall be installed in accessible locations. Boxes in otherwise inaccessible locations shall be accessible from ceiling space access panels. Ceiling-mounted outlet boxes for lighting fixtures, fittings, and wiring devices shall be symmetrical, except as otherwise indicated, and shall not interfere with the work of other trades.

Wall outlet boxes for single or two -gang flush wiring devices shall be not less than 100 millimeter square and 40 millimeter deep. Wall outlet boxes for multiple-gang flush wiring devices shall be not less than 115 millimeter wide and 65 millimeter deep. Wall-mounted outlet boxes for lighting fixtures and flush devices shall be capable of withstanding a vertical downward force of 225 newton for a period of 5 minutes.

Boxes shall be formed from carbon-steel sheets of commercial quality, not less than 1.9 millimeter. Boxes shall be one-piece construction, zinc- or cadmium-plated in accordance with UL 514A. Boxes and box extension rings shall be provided with knockouts. Boxes shall be designed for mounting flush wiring devices.

Exposed surface junction boxes shall be installed only in equipment rooms

and other utility areas.

Surface-mounted boxes shall be outside flange type with a matching solid flat cover. Flush-mounted boxes in walls and floors shall be the outside flange type with a matching recessed solid walkway cover. Box bodies and covers shall be galvanized by the hot-dip process in accordance with ASTM A 123, Class A.

2.3.2 Cast-Metal Boxes

Cast-metal pull and junction boxes having an internal unobstructed air space of more than 0.0016 cubic meter for connection to galvanized rigid steel conduits embedded in concrete or surface mounted shall be watertight rectangular boxes in accordance with UL 50 and NEMA FB 1.

Box bodies and covers shall be cast or malleable iron with a wall thickness not less than 3 millimeter at every point, of greater thickness at reinforcing ribs and cover edges, and not less than 6 millimeter in thickness at tapped holes for rigid steel conduit. Box bodies shall be provided with integral threaded conduit openings, as required. Mounting lugs shall be provided at the back or at the bottom corner of the box body. Boxes shall be provided with neoprene cover gaskets that will prevent the entrance of water into the enclosure. Covers shall be secured to box bodies with 4.1 millimeter diameter (AWG No. 6) or larger brass or bronze flathead screws.

2.3.3 Pull and Junction Boxes

Pull and junction boxes shall be fabricated from carbon steel and shall conform to UL 50. Box dimensions and conduit connections shall conform to NFPA 70.

Boxes shall be welded construction with flat removable covers fastened to the box with machine screws. Seams and joints at corners or back edges of the box shall be closed and reinforced with flanges formed of the same material from which the box is constructed or by other means such as continuous welding which provides a construction equivalent to integral flange construction.

Boxes intended for outdoor use shall be cast with threaded hubs and neoprene-gasketed covers.

Boxes intended for use in dry locations shall be sheet steel hot-dipped galvanized after fabrication conforming to UL 514A.

PART 3 EXECUTION

3.1 INSTALLATION

Power, lighting, control emergency light and power, and special-service systems and all related components shall be installed in accordance with NFPA 70, and shall be enclosed in separate conduit or separate conduit systems.

Any run of EMT, intermediate, or rigid conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain not more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting. Installed conduit and fittings shall be free of dirt and trash and shall not be deformed or crushed. Empty conduit shall have a pull rope stalled.

Conduit shall be installed with a minimum of 75 millimeter of free air space separation from mechanical piping.

Conduit in finished areas shall be installed concealed. Conduit passing through masonry or concrete walls shall be installed in sleeves.

Conduit shall be securely clamped and supported at least every 3000 millimeter vertically and 2400 millimeter horizontally. Galvanized pipe straps shall be fastened to structure with bolts, screws, and anchors. Wooden masonry plugs shall not be used.

Conduit and boxes shall not be supported from T-bar ceiling wires.

All recessed outlet boxes in non-combustible walls or ceilings shall be installed flush, such that the outlet box is set back less than 2 millimeter or protrudes less than 2 millimeter from the face of the ceiling or wall.

Conduit connections to boxes and fittings shall be supported not more than 900 millimeter from the connection point. Conduit bends shall be supported not more than 900 millimeter from each change in direction. Conduit shall be installed in neat symmetrical lines parallel to the centerlines of the building construction and the building outline. Multiple runs shall be parallel and grouped whenever possible on common supports. All conduits which terminate at cable tray shall be securely fastened to the tray using approved fittings.

Conduit and raceway runs in or under concrete, in damp, corrosive, or outdoor locations, in hazardous areas, where subject to mechanical damage, or intended for conductors rated over 600 volts, shall be rigid steel conduit. Conduit joints in corrosive areas shall be painted with corrosion or acid-inhibiting compounds.

Ends of conduit extending from the interior to the exterior of the building and portions of interior conduit exposed to widely varying temperatures shall be sealed to prevent the passage of air within the conduit. Conduit shall be sloped to drain and shall be provided with drainage fittings at the lower end of the run. Curved portion of conduit bends shall not be visible above the finished floor. Underground service entrance and feeder conduit entering or leaving the building above the ground floor shall be terminated in a pull box.

Expansion fittings with flexible ground strap shall be provided in conduit runs crossing building expansion joints.

Underground portions of conduit runs shall be painted with bitumastic or shall be provided with a factory-applied coating of PVC not less than 5 millimeter thick. Underground conduit encased in concrete does not require

a protective coating of PVC. When the factory-applied coating is chosen by the Contractor, any nicks, cuts, or other abrasions shall be wrapped with a single layer of 0.254 millimeter thick pressure-sensitive PVC tape, half-lapped to obtain a minimum thickness of 5 millimeter. Couplings shall be wrapped with pressure-sensitive tape, as described above, over the coupling and for 50 millimeter on each side of the coupling. When precoated couplings designed for the purpose are used, taping may be omitted provided the manufacturer's adhesive is used between the coating on the coupling and the coating on the conduit. Field bends shall be made in accordance with the manufacturer's recommendations, which normally require use of a one-size-larger bender than would be required for uncoated conduit. Depth of buried conduit shall be in accordance with NFPA 70 or as indicated on the contract drawings.

Exposed ends of conduit without conductors shall be sealed with watertight caps or plugs.

Bushings shall be provided on the open ends of conduit containing conductors. Insulated bushings shall be provided for conduits containing conductors AWG No. 4 or larger with an insulating ring an integral part of the bushing.

Flexible metallic conduit shall be used to connect recessed fixtures from outlet boxes in ceilings, metallic transformers, and other approved assemblies. Sections of flexible steel conduit shall be not more than 1800 millimeter long and shall be installed only in exposed or accessible locations. Interior surfaces of conduit shall be free from burrs and sharp edges which might cause abrasion of wire and cable coverings. Ends of flexible steel conduit shall be provided with grounding bushings and approved fittings.

Bonding wires shall be used in flexible conduit for all circuits. Flexible conduit shall not be considered a ground conductor.

Liquidtight flexible metallic conduits shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit in a manner that will not impair the function of the equipment.

Wire or cable shall not be installed in conduit until the conduit system is completed; the inner surfaces of conduit shall be clean and dry.

A nylon or polypropylene pull rope with a tensile strength not less than 580 newton shall be installed in empty conduit.

3.1.1.1 Installation of Rigid Metal Conduit and Intermediate Metal Conduit

Ends of conduit shall be cut square, reamed and threaded, and joints shall be brought butt-to-butt in the couplings. Joints shall be mechanically tight. Conduit shall be protected against damage and the entrance of water or foreign material during construction.

Ninety-degree bends of conduit with a diameter larger than 25 millimeter shall be made with factory-made elbows. Conduit elbows larger than 65 millimeter shall be long radius. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Changes in directions of runs shall be made with symmetrical bends or cast-metal fittings.

At connections to sheet metal enclosures and boxes, a sufficient number of threads shall project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be pulled up sufficiently tight to draw the bushing into firm electrical contact with the box. Conduit shall be fastened to sheet metal boxes and cabinets with two locknuts where required by NFPA 70 where insulating bushings are used, where bushings cannot be brought into firm contact with the box, and where indicated.

Conduit joints shall be made with tapered threads set firmly. Each length of conduit cut in the field shall be reamed before installation. Where conduit is threaded in the field, each threaded end shall consist of at least five full threads. Corrosion-inhibitive compound shall be used on conduit threads in exterior areas.

Conduit stubbed-up through concrete floors for connections to free-standing equipment except motor-control centers, cubicles, and other such items of equipment shall be provided with a flush coupling if the floor slab is of sufficient thickness; if not, a floor box shall be provided and set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.2 Installation of Rigid PVC Conduit

Rigid PVC conduit for underground work shall be encased in a concrete envelope unless otherwise indicated on the contract drawings.

A continuous, bare, soft-drawn copper ground wire shall be run in conduit with conductors and shall be solidly connected to ground at each end. Ground wires shall be sized in accordance with NFPA 70.

Rigid PVC conduit shall be stored on a flat surface and shall be protected from the direct rays of the sun.

3.1.3 Installation of EMT

EMT shall be cut square and reamed to remove burrs and rough surfaces.

Field-made bends and offsets shall be avoided where possible but, where necessary, shall be made with an approved hickey or conduit-bending machine. Changes in direction of runs shall be made with symmetrical bends or approved metal fittings.

3.1.4 Installation of Flexible Metallic Conduit

Flexible metallic conduit shall be installed only in exposed, accessible locations in accordance with NFPA 70. A grounding green conductor shall be

installed in all runs. Connections to motors and vibrating equipment shall be made with flexible metallic conduit.

3.2 INSTALLATION OF WIRING

Raceways shall be completely installed, with interiors protected from the weather, before proceeding with the installation of wires and cables. Conductors of special-service systems and emergency light and power systems shall not occupy the same enclosure with light and power conductors or the same enclosure with each other. Conductors shall be continuous with splices and connections made in outlet, junction, or pull boxes only. All control wiring shall be continuous between components and/or terminal boards.

Phase conductors and the neutral conductor of each branch or feeder circuit shall be contained in a single enclosure or paralleled in separate enclosures to avoid overheating the raceway by electromagnetic induction. Conductors and conduit in parallel shall be the same length and size, shall have conductors of the same type of insulation, shall be terminated at both ends in a manner to ensure equal division of the total current among conductors, and shall have a separate neutral conductor in each conduit.

Sharing of a common neutral between single phase circuits, connected to different phases, shall not be permitted.

Conductors installed in rigid metal conduit and EMT shall have allowable current-carrying capacity and ampere ratings in accordance with NFPA 70. Larger-sized conductors shall be used to compensate for derating factors when more than three current-carrying conductors are installed in raceways and when conductors are installed in wet locations.

Conductors 600 volts and below shall be color coded in accordance with the following:

| <u>CONDUCTOR</u> | 120/208 <u>COLOR</u> | 480/277 <u>COLOR</u> |
|-------------------|-------------------------|-------------------------|
| Phase A | Black | Brown |
| Phase B | Red | Orange |
| Phase C | Blue | Yellow |
| Neutral | White | White/Gray |
| Equipment Grounds | Green | Green |

Conductors up to and including AWG No. 6 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 6 shall have ends identified with colored plastic tape in outlet, pull, or junction boxes and at terminations. Control circuit conductors shall be identified at each connection point.

Connectors and splices shall conform to UL 486C and shall be made in

approved enclosures utilizing solderless pressure connectors and adequate insulation with vinyl-plastic electrical insulating tape. Conductors and materials used in a splice, tap, or connection shall be thoroughly cleaned prior to makeup to ensure good electrical and mechanical connections. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable. Control-circuit terminals of equipment shall be properly identified by color-coded insulated conductors, number-coded plastic self-sticking printed markers, or permanently attached metal-foil markers. Cable fittings shall conform to UL 514B; insulating tape shall conform to ASTM D 2301.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation. Tags shall be engraved laminated phenolic, with black lettering (1/8 inch high) on white background, fastened to cables by means of tie wrap through a hole drilled at one end of the tag.

Grounding shall be provided in accordance with NFPA 70. Noncurrent-carrying parts of electrical equipment shall be bonded and grounded together.

3.3 BOXES AND FITTINGS

Pullboxes shall be furnished and installed where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 30 meter or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Bonding jumpers shall be used around concentric or eccentric knockouts.

3.4 FIELD TESTING

After completion of the installation and splicing, and prior to energizing the conductors, wire and cable shall be given continuity and insulation tests as herein specified before the conductors are energized.

Necessary test equipment, labor, and personnel shall be provided by the Contractor to perform the tests, as herein specified. Continuity tests shall be conducted using a dc device with bell or buzzer.

Wire and cable in each voltage classification shall be completely isolated from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Final acceptance will depend upon the successful performance of wire and cable under test. No conductor shall be energized until the installation

is approved.

-- End of Section --

SECTION 16286

OVERCURRENT PROTECTIVE DEVICES
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167 (1994; Rev A) Standard Specification for
Stainless and Heat-Resisting
Chromium-Nickel Steel Plate, Sheet, and
Strip

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250 (1997) Enclosures for Electric Equipment
(1000 Volts Maximum)

NEMA ICS 1 (1993) Industrial Control and Systems
General Standards

NEMA ICS 2 (1993) Industrial Control and Systems
Controllers, Contactors, and Overload
Relays Rated Not More Than 2000 Volts AC
or 750 Volts DC

NEMA ICS 3 (1993) Industrial Control and Systems
Factory Built Assemblies

NEMA ICS 6 (1993) Industrial Control and Systems
Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 50 (1995; 11th Ed) UL Standard for Safety -
Enclosures for Electrical Equipmen

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330,
"Submittals," in sufficient detail to show full compliance with the
specification:

SD-01 Data

Equipment and Performance Data shall be submitted for the following items including use life, system functional flows, safety features, and mechanical automated details.

Remote Telemetry System
Fuses
Control Devices
Indicating Lights

SD-01 Data

Manufacturer's Catalog Data shall be submitted for the following items:

Remote Telemetry System
Enclosures
Fuses
Control Devices
Indicating Lights

SD-04 Drawings

Connection Diagrams shall be submitted showing the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Remote Telemetry System
Control Devices
Protective Devices

SD-06 Instructions

Manufacturer's Instructions shall be submitted for the following items, including special provisions required to install equipment components and system packages. Special notices shall detail, resistance impedances, hazards and safety precautions.

Remote Telemetry System
Control Devices
Protective Devices

SD-09 Reports

Test Reports shall be submitted for the following tests on control and protective devices in accordance with the paragraph entitled, "Field Testing, of this section.

Operation Tests
Dielectric Tests

SD-18 Records

No change in continuous-current rating, interrupting rating, and clearing or melting time of fuses shall be made unless written permission has first been secured from the Contracting Officer.

1.3 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

PART 2 PRODUCTS

2.1 ENCLOSURES

2.1.1 Equipment Enclosures

Enclosures for equipment shall be in accordance with NEMA 250.

Equipment installed inside, clean, dry locations shall be contained in NEMA Type 1, general-purpose sheet-steel enclosures.

Equipment installed in wet locations shall be contained in NEMA Type 4 watertight, corrosion-resistant stainless-steel enclosures, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

Equipment installed in industrial locations shall be contained in NEMA Type 12 industrial use, sheet-steel enclosures constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Equipment installed in Class I, Division I, Group A, B, C, and D, hazardous locations shall be contained in NEMA Type 7 enclosures approved for the specific flammable gas or vapor which is or may be present under normal operating conditions.

Equipment installed in Class II, Division I, Group E, F and G, hazardous locations shall be contained in NEMA Type 9 enclosures approved for use where combustible dust is or may be present under normal operating conditions.

Sheet-steel enclosures shall be fabricated from uncoated carbon-steel sheets of commercial quality, with box dimensions and thickness of sheet steel in accordance with UL 50.

Steel enclosures shall be fabricated from corrosion-resistant, chromium-nickel steel sheet conforming to ASTM A 167 Type 300 series with ASM No. 4 general-purpose polished finish. Box dimensions and thickness of sheet steel shall be in accordance with UL 50.

Ferrous-metal surfaces of electrical enclosures shall be cleaned, phosphatized, and painted with the manufacturer's standard finish.

2.1.2 Remote-Control Station Enclosures

Remote-control station enclosures for pushbuttons, selector switches, and indicating lights shall be in accordance with the appropriate articles of NEMA ICS 6 and NEMA 250.

Remote-control stations installed in indoor, clean, dry locations shall be contained in NEMA Type 1 general-purpose, stainless-steel enclosures. Recessed remote-control stations shall be contained in standard wall outlet boxes with matching corrosion-resistant steel flush cover plate.

Remote-control stations installed in wet locations shall be contained in NEMA Type 4 watertight, corrosion-resistant stainless-steel enclosures constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 and NEMA 250 for Type 4 enclosures.

Remote-control stations installed in industrial locations shall be contained in NEMA Type 12 industrial-use, sheet-steel enclosures constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Remote-control stations installed in Class I, Division I, Group A, B, C, and D, hazardous locations shall be contained in NEMA Type 7 enclosures approved for the specific flammable gas or vapor which is or may be present under normal operating conditions.

Remote-control stations installed in Class II, Division I, Group E, F and G, hazardous locations shall be contained in NEMA Type 9 enclosures approved for use where combustible dust is or may be present under normal operating conditions.

Sheet-steel enclosures shall be fabricated from uncoated carbon-steel sheets of commercial quality with box dimensions and thickness of sheet steel in accordance with UL 50.

Steel enclosures shall be fabricated from corrosion-resistant, chromium-nickel steel sheet conforming to ASTM A 167, Type 300 series with ASM No. 4 general-purpose polished finish. Box dimensions and thickness of sheet steel shall be in accordance with UL 50.

Ferrous-metal surfaces of remote-control-station enclosures shall be cleaned, phosphatized, and painted with the manufacturer's standard finish.

Remote-control stations shall be installed with the centerline 1700 millimeter above the finished floor.

PART 3 EXECUTION

3.1 INSTALLATION

Control and protective devices not factory installed in equipment shall be installed in accordance with the manufacturer's recommendations and shall be field adjusted and tested for operation. Installations shall conform to NFPA 70, NEMA ICS 1, NEMA ICS 2, and NEMA ICS 3 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Control and protective devices not factory installed in equipment shall be demonstrated to operate as indicated.

-- End of Section --